APPENDIX VIII

PUBLIC HEALTH

COMPREHENSIVE OCEAN AREA PLAN

This appendix has been prepared as a contribution to the California Comprehensive Ocean Area Plan (COAP).

The subject matter herein has been developed following discussions with COAP staff, however the content remains the responsibility of the contributing agencies

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PUBLIC HEALTH IN THE COASTAL ZONE

REPORTS FOR THE COMPREHENSIVE OCEAN AREA PLAN

FROM THE:

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

("Health and Human Ecology in the Coastal Zone" and "Solid Wastes and the Coastal Zone")

STATE WATER RESOURCES CONTROL BOARD

("Water Quality Control")

CALIFORNIA DEPARTMENT OF WATER RESOURCES

("Hydrologic Aspects of the Coastal Zone")

MARCH 1972

"The preparation of this Report was financed in part through an Urban Planning Grant from the Department of Housing and Urban Development, under the provisions of Section 701 of the Housing Act of 1968, as amended".

APPENDIX IX - PUBLIC HEALTH

PART I

SOLID WASTES

PART II

A. WATER QUALITY AND AVAILABILITY

PART 1

California Department of Public Health
Bureau of Vector Control and Solid Waste Management

INTRODUCTION

Solid wastes include all of the solid and semisolid, unwanted materials generated by human activities. They include such materials as household, commercial and institutional refuse, abandoned autos, demolition debris, some industrial process wastes, agricultural crop wastes, and manure.

These waste materials are objectionable owing to characteristics which may include disease relationships, offensive odors, unsightliness, safety hazards, or other possible threats to the environment. Historically, a system of solid waste management has evolved to "dispose" of the accumulations of solid wastes. Unfortunately this system has been an out-of-sight, out-of-mind approach emphasizing minimum costs while compromising environmental safeguards.

Solid waste management should be considered to include all steps in the handling of waste materials including the storage, collection, transportation, processing, utilization and disposal. Solid waste management also encompasses the regulatory constraints governing the system. In California, operational aspects of the system are conducted by city and county governments, special districts, private contractors, and by the individual waste producers. Regulation is provided by local governments and the State.

This discussion is primarily based on data collected by the Statewide solid waste management planning study of the State Department of Public Health, revised to reflect 1970 conditions. For the purposes of this discussion, the Coastal Zone has been defined as including all land within one mile of the seashore,

estuaries, and bays, but excluding the San Francisco and San Pablo bay areas behind the Golden Gate Bridge (under the jurisdiction of the Bay Conservation and Development Commission). The Coastal Zone also includes the ocean area within the jurisdiction of the State.

The generation of solid wastes is increasing with population growth and productivity. The historic management philosophy of minimal investment of money and effort is being forced to respond to pressures of population density and environmental concern. The most permanent effect of solid wastes on the Coastal Zone is through the use of land for disposal. Since a substantial part of the State's waste production is located near the coast, there is strong economic pressure to use these coastal areas for disposal of wastes. In addition to the problems of land use, failure to contain wastes properly in storage or while being transported may significantly impair the aesthetic value of the area and may also result in water or air pollution and the production of disease vectors or fire hazards. In recreational areas the storage and collection system which must be prepared seasonally to cope with a surge of wastes beyond normal equipment capabilities frequently comes under severe criticism for not functioning effectively.

This discussion presents the existing status of the solid waste management system in the Coastal Zone, including its environmetal impact. Also included is a projection of trends and a look at the potential effects of developing technologies. Recommendations are offered regarding policies desirable if public health is to be protected and an acceptable environment is to be maintained.

CURRENT CONDITIONS

Solid wastes in the Coastal Zone emanate from a wide variety of municipal, industrial, and agricultural sources. The rate of solid waste production in an area from these sources is generally proportional to population density, industrial development, and the nature and intensity of agricultural production.

Solid Waste Production

There is no feasible method to determine the precise quantities of solid wastes generated in the Coastal Zone. The inland boundary of the Zone is an arbitrary line which passes through major metropolitan areas. Planning and management system boundaries usually follow jurisdiction boundaries; therefore, wastes may be transported into the Coastal Zone for disposal or wastes from the Coastal Zone may be transported elsewhere for disposal. Estimates of municipal solid wastes produced in 1970 in the 15 coastal counties are given in Table 1. If the inland portions of San Francisco, Los Angeles and Orange counties are grouped with the coastline portions of the other counties, about 60 percent of California's municipal-type solid waste production, or roughly 13.5 million tons per year, originates in or adjacent to the Coastal Zone. The management of the industrial and agricultural solid wastes produced within this area must also be considered in future plans.

Table 1

MUNICIPAL SOLID WASTE PRODUCTION--1970

County	Total County Annual Tonnage
Del Norte	12,000
Humboldt	90,000
Mendocino	43,000
Sonoma	191,000
Marin	211,000
San Francisco	1,056,000
San Mateo	624,000
Santa Cruz	120,000
Monterey	258,000
San Luis Obispo	103,000
Santa Barbara	267,000
Ventura	398,000
Los Angeles	9,236,000
Orange	1,764,000
San Diego	1,742,000
Total	16,115,000

Collection and Transportation

The manner in which wastes are collected or transported from their point of origin is determined by the kind of waste. Industrial wastes, if not processed on premises, are commonly transported by the producer or a special industrial waste hauler. Agricultural wastes are usually not transported off the farm or ranch.

Refuse collection services are currently available to residential commercial and institutional developments in most of the urban portions of the Coastal Zone. In cities, this service may be operated by a municipal collection agency or by a franchised refuse removal contractor. In the unincorporated areas, refuse collection

may be established through franchised areas or merely as a service available. In such areas, the service is often directly responsive to population density and ease of transportation, and may therefore be available only in areas surrounding communities or along main highways. Subscription to refuse collection services is not mandatory, and many persons continue to haul their own wastes to a local disposal site.

Equipment utilized by the refuse removal agencies is undergoing continuous improvement. A few old, open trucks are still used on refuse collection routes, but most have been replaced by the more efficient units equipped with compaction-type bodies to allow a greater payload.

Disposal Management

It is beyond the scope of this discussion to consider in detail the management aspects of solid waste programs. Various county solid waste disposal programs are available which can be amended to accommodate future Coastal Zone development. County health departments and public works departments are the agencies assuming primary responsibility for solid waste management (Table 2). Public works departments and similar agencies, such as engineering, and road departments, usually perform the task of planning for disposal sites. In some counties the land-use planning agency does not have any responsibility for solid waste disposal other than issuing land-use permits.

Twelve of the counties have solid waste ordinances, six of which include standards for disposal site operation. This may suggest a more optimistic picture than actually exists, however, since not

all of these ordinances have been enforced, and in some cases, where the county has attempted to have a rigorous enforcement program, a nonconforming disposal site may be located within a city where the ordinance does not apply.

All of the counties require land-use permits for disposal sites. In addition, six require a second special disposal site permit. The county health department also has the responsibility for inspecting private disposal sites.

It is a sign of progress that five counties have completed planni studies. San Mateo County completed a waste disposal site survey in 1963 and has since issued staff reports updating the data contained in that earlier survey and has done special studies of individual proposed disposal sites. At present, however, the San Mateo County studies have only been partially implemented, and the County has not taken firm control of the disposal program. Santa Barbara County has established a large capacity regional disposal site which receive wastes from a regional transfer station. Additional wastes may go to this site in the future as other sites are filled to capacity. Planning in Los Angeles County is undertaken by a number of agencies. Cooperative agreements for operation and utilization of the disposal sites exist between the County and the Los Angeles County Sanitation Districts. In addition to the municipally-owned sites a large number of privately-operated disposal facilities have been used. The capacity of present disposal sites in the coastal portions of Los Angeles County is rapidly declining, and it is anticipated that wastes from these areas will be transferred inland to large canyon sites.

Table 2

SOLID WASTE DISPOSAL - COUNTY MANAGEMENT ASPECTS

County	Agencies Responsible For S.W. Management 1/	Agencies Responsible For S.W. Disposal Planning	County Master S.W. Disposal Plan Status	S.W. Ordinance	Ordinance Includes Site Standards	Type of Permit Required for Site 2/	Agency Issuing Permit	Agency Inspecting Private Sites
Del Norte	A,HD,PL,RD,LE	HD	None	Yes	No	LU	PL	HD
Humboldt	HD,PW	PW	In Progress	No	-	LU	PL	HD
Mendocino	HD,PW	HD	None	Yes	Yes	DS,LU	A,HD	HD
Sonoma	A,HD,PL,RD	RD	Completed	Yes	Yes	LU	E	(a)
Marin	HD,PW	PW	None	No	-	DS,LU	HD	HD
San Francisco	A,HD,PW,E,RD	E	None	Yes	Yes	DS,LU	PW, PL	PW
San Mateo	HD,E,PL	E	Completed	Yes	No	DS,LU	A,PL	HD
Santa Cruz	HD,PW,E,PL	PW	None	No	-	LU,F	A	PW
Monterey	HD,PW,PL,RD,LE, SWC	SWC	None	Yes	None	LU	PL	(a)
San Luis Obispo	A,HD,PL,SWC	HD	None	Yes	Yes	LU	A, HD, PL	HD
Santa Barbara	A,HD,PW	PW	Completed	Yes	Yes	LU	PW	PW
Ventura	HD,PW,PL,LE	PW	Completed	Yes	No	LU	PL	PL
Los Angeles	HD,E,LE,SWA	E	In Progress	Yes	Yes	DS,LU	E	E
Orange	A,RD,LE	RD	Completed	Yes	No	DS,LU	A,(b)	(b)
San Diego	HD,PW,PL	PW	In Progress	Yes	No	LU	PL	PW

1/Types of County Agencies

A - Administrative
HD - Health Department
PW - Public Works
E - Engineering
PL - Planning
RD - Road Department
LE - Law Enforcement
SWC - Solid Waste Committee
SWA - Solid Waste Agency

2/Type of Permit

DS - Disposal Site Permit
LU - Land-Use Permit
F - Franchise

(a)-All Authorized Sites Publicly Operated
(b)-Orange County-Water Pollution Dept.

ote: This table has been adapted from Statewide data compiled by the Dept. of Public Health as a part of the California Solid Waste Planning Study.

There are a variety of State and local agencies which have a role in the development of solid waste programs. For example, the State Department of Agriculture has jurisdiction relative to garbage fed to hogs, and disposal of garbage from vessels and aircraft. The State Department of Conservation, Division of Forestry, issues "rubbish dump permits", concerned primarily with fire control. The Regional Water Quality Control Boards have jurisdiction relative to water pollution from solid waste disposal. The California Department of Public Health serves in an advisory capacity to local agencies for the development and implementation of solid waste program

Most county and city governments within the study area have ordinances relating to solid waste disposal. There are also State laws relating to certain aspects of solid waste disposal in the State codes. These are found primarily in the Health and Safety Code, the Public Resources Code, the Vehicle Code, the Penal Code, and the Administrative Code.

Processing and Disposal

The processing of solid wastes includes volume reduction techniques such as incineration, grinding and baling. Also included are methods used to reclaim a portion of the waste output such as composting and pyrolysis, and salvage of metals and papergoods. Each processing technique is not complete within itself inasmuch as a fraction remains as an unwanted waste. Currently, little processing solid wastes is accomplished in the Coastal Zone (as in all of California). Some small incinerators are in use at commercial establishments and at institutions. Some remotely located residents

continue to rely on the backyard burning barrel. Although only a few exist within the Coastal Zone, the forest products industries do utilize the large conical burners to burn sawdust and other wood wastes. Units still in operation are plagued with the unwelcome characteristics of smoke, particulate matter and odor common to all inefficient burning of solid wastes.

The ultimate disposal of waste, or the final step in any system, utilizes either the land or the ocean as the disposal point.

The history of refuse disposal in the Coastal Zone has seen some incredible uses of the land-water contact. The last disposal site situated where wastes could be cascaded off of a cliff into the ocean was closed on the Mendocino Coast in 1970. Present methods of disposal of wastes to land are limited primarily to burial in landfills or spreading on the ground.

There are currently 21 land disposal sites in use within the Coastal Zone (Table 3). Twelve of these have used open burning to some degree.* Only three of the disposal sites are operated in a manner which meets the criteria recommended for proper disposal of refuse; these are sanitary landfills where all refuse received at a disposal site is compacted and buried with an earth cover at the end of each day the site is open. At most of the landfills, the refuse is covered only periodically, and hence problems such as flies, rodents, birds, blowing papers, accidental fires and unsightliness exist.

The physical setting of some of the existing disposal sites is unsuitable. For example, the Daly City site is situated on a

*Recently adopted State regulations now prohibit any open burning of refuse at disposal sites. There are provisions which allow for extension of burning for a limited time in hardship cases.

Table 3

SOLID WASTE DISPOSAL SITES

County	Site Name	Location	Latitude	Type[1/]	Tons Per Day	Acres	Service Area	Completion Date
Del Norte	Fort Dick	0.7 mi. from ocean	41° 52'	UBD	<1	22	Fort Dick, Smith River	1990
	Crescent City	0.6 mi. from ocean	41° 48'	SDB	10	40	Crescent City	1990
	Klamath	0.3 mi. from Klamath River at point 3.5 mi. from mouth, 2.0 mi. from ocean	41° 31'	UBD	<1	18	Klamath	1980
Humboldt	Orick	0.9 mi. from ocean	41° 17'	UBD	1	7	Orick, Trinidad	1980
	Arcata	adjacent to Arcata Bay, 3.5 mi. from ocean	40° 52'	MSLB	55	80	Arcata, Blue Lake, Samoa	1990
	Table Bluff	0.2 mi. from ocean	40° 41'	UBD	30	160	Fortuna, Rio Dell, Scotia	1990
	Shelter Cove	0.5 mi. from ocean	40° 01'	UBD	<1	1	Shelter Cove	unk.
Mendocino	Elk	0.5 mi. from ocean	39° 08'	UBD	<1	5	Elk	1975
San Mateo	Daly City	adjacent to ocean (sea wall)	37° 41'	MSL	79	43	Daly City, Pacifica	unk.
	Half Moon Bay	0.2 mi. from ocean	37° 27'	MSL	4	5	Half Moon Bay, Montara	1971
	Pescadero	0.3 mi. from ocean	37° 15'	MSL	5	3	Pescadero, San Gregorio	1972
Santa Cruz	Davenport	adjacent to ocean (beach)	37° 01'	UBD	1	1	Davenport	indef.
	Santa Cruz	0.9 mi. from ocean	36° 59'	SDB	100	100	Santa Cruz	1985
Monterey	Monterey Peninsula	adjacent to Salinas River at point 3.5 mi. from mouth, 1.7 mi. from ocean	36° 42'	SL	200	550	Carmel, Pacific Grove, Monterey, Seaside, Del Rey Oaks, Sand City	2050
	Pacific Valley	0.3 mi. from ocean	35° 53'	MSL	<1	1	Pacific Valley, Gorda	unk.
San Luis Obispo	Cambria	0.6 mi. from ocean	35° 36'	SDB	1	3	Cambria	1971
Santa Barbara	Tajigous	0.6 mi. from ocean	34° 29'	SL	410	132	Santa Barbara, Carpinteria, Goleta, Naples	2000
Los Angeles	Pebbly Beach	0.1 mi. from ocean	33° 20'	UBD	2	3	Avalon, Santa Catalina Is.	indef.
Orange	Bolsa Chica	1.0 mi. from ocean, 0.6 mi. from Bolsa Bay	33° 43'	MSL	10	10	local OrangeCo. metro. area	1980
	Steverson	0.6 mi. from ocean	33° 39'	MSL	25	40	local OrangeCo. metro. area	1972
San Diego	Oceanside	0.9 mi. from ocean	33° 12'	SL	70	12	Oceanside	1975

1/ UBD - uncontrolled burning dump
SDB - supervised dump with burning
MSLB - modified sanitary landfill with burning
MSL - modified sanitary landfill
SL - sanitary landfill

terrace at the edge of the ocean. This location is a land slippage zone which is slowly forcing the buried refuse into the ocean. An attempt is being made to combat this movement by installation of a seawall, however such protection is vulnerable to the constant battering of the ocean waves, and maintenance will have to be provided perpetually. In the northern coastal area the high annual precipitation presents the threat of water pollution and nuisance conditions. Leachate from the buried refuse must be controlled in such areas.

Other methods of land disposal in addition to the refuse landfills include disposal onto the surface of the land, e.g., plowing agricultural wastes into the soil, or allowing waste timber and slash to remain in the harvested areas of the forest. Indiscriminant dumping and littering also is prevalent in rural areas and areas of high recreational use. Such wanton abandonment of solid wastes defaces the natural beauty of this area and contributes to such hazards as increased fire danger and cuts by sharp cans or broken bottles on beaches.

The current manner by which the disposal of solid wastes on land takes place often restricts the uses which may be made of adjacent land and the disposal area property itself. Even after disposal operations have ceased, the landfill is still "alive"--undergoing processes of decomposition, consolidation and settlement. Hence, secondary use of the disposal site is physically restricted by uneven settlement of the final fill contours and by the dangers presented by the gases generated from the buried refuse. Unless

special techniques for building construction are utilized or the wastes are pre-treated, finished landfills should be relegated to open space land use.

Several areas in the ocean off the California coast are used as points of waste disposal. Wastes such as dredging spoils, cannery sludge, limited amounts of garbage and rubbish, industrial chemicals, explosives, and radioactive wastes are or have been discharged into these offshore areas. Information regarding such disposal practices has been developed by the Dillingham Corporation study which inventoried existing marine disposal of solid wastes nationwide under contract to the U.S. Public Health Service.

The dumping areas are located (a) near the Farallon Islands to serve the San Francisco Bay area,(b) between Santa Cruz and San Clemente Islands off the Los Angeles coastline, and (c) in the ocean off San Diego. The San Francisco Bay Regional Water Quality Control Board has recently taken action to restrict the use of the disposal area near the Farallon Islands. Prior to this time between 10,000 and 25,000 tons of cannery solid wastes such as pulp, pits and peelings were disposed of in this area annually. Some 500 tons of navy munitions were dumped in this area in 1968-69. The disposal of wastes in the other areas is under the regulation of the appropriate regional water quality control board.

Two State laws are directly concerned with the disposal of garbage and other refuse in the ocean off the California coastline. The California Health and Safety Code prohibits depositing refuse in or upon the navigable waters of the State or at any point in the ocean within 20 miles of the coastline of the State. This law was passed in 1911 in response to the concern over garbage and rubbish

drifting back to shore. This problem stemmed from use of an ocean area 10 miles offshore from San Francisco for disposal of refuse from Oakland and other East Bay cities. State Department of Agriculture regulations covering disposal of refuse from vessels and aircraft offer ocean disposal of these wastes beyond the 20-mile limit as an acceptable disposal method. Refuse from naval vessels in the Long Beach and San Diego areas has been handled routinely in this manner. Currently, wet garbage from naval vessels in the San Diego area is cooked and then disposed of along with the rubbish in landfills serving San Diego. Approximately 50 tons of wastes are still taken out to sea from the Long Beach area each week.

The ocean also receives various miscellaneous waste items ranging from confiscated materials to spoiled foods. These disposal operations are usually scheduled on an as needed basis and no established disposal areas are used. Materials are handled in crates or barrels, or as loose items.

The federal Council on Environmental Quality recommended in late 1970 that the United States should take the lead in prohibiting or severely restricting the use of the oceans as dumping grounds. This has been endorsed by President Nixon and a promise has been made to introduce legislation implementing the Council's report.

FUTURE CONDITIONS

The increasing concern for protection of environmental quality will stimulate the replacement of unsatisfactory solid waste management practices presently in use. While complete change-over to improved solid waste handling systems will require many years, substantial improvement can be made to alleviate nuisances and pollution with existing technology.

Forecast

New concepts for minimizing the quantity of solid wastes produced, new waste processing and disposal techniques, and new waste reclamation methods are now being sought. Research development efforts for improving solid waste management practices are receiving a new and substantial financial stimulus through the federal government's solid waste program. Practical results stemming from most of these newly developed techniques are still probably 5 to 10 years away. The immediate future will require continued use of established technology, with gradual acceptance of sounder principles, procedures, techniques and equipment now being developed.

General areas of concern to be reckoned within solid waste management in the Coastal Zone will include upgrading the practices of refuse storage and removal from points of waste production, planning for future solid waste disposal or reclamation, and improving the quality of waste handling and disposal practices. As population densities within the Coastal Zone increase and recreational uses expand, corresponding increases in solid waste production can be expected. As previously indicated, it is not possible to estimate precisely the amount of solid wastes produced in the Coastal Zone because of the metropolitan areas which overlap the coastal

and inland zones. It is anticipated, however, that the solid waste production in California will increase by almost 70 percent above today's production levels by 1985, and over 150 percent by the year 2000.

Improved Solid Waste Collection Services

Residential and recreational areas along low-speed coastal transportation routes will provide the perplexing problem of low volumes of wastes coupled with sparse distribution. These areas will face a disproportionate financial burden per unit cost in improving solid waste collection and disposal systems. Those portions of the Coastal Zone now outside of the metropolitan areas will rely more extensively on refuse collection services. This will be necessary since the disposal sites serving these areas may be too remote to make it economical for a resident to haul his own wastes. Subscription to the refuse collection service in these remote portions of the Coastal Zone may have to be made mandatory to prevent the increased occurrence of promiscuous dumping by those residents not using the service. Providing more facilities and refuse removal service in recreation areas should also reduce litter from visitors. These recreational area waste disposal systems will have to cope with sporadic and seasonal surcharges of wastes.

Several financing arrangements are available to encourage subscription to the collection service. In those areas within the jurisdiction of a special purpose district empowered to regulate refuse collection practices, the refuse collection fee might be collected in conjunction with the fees for the other utility services.

An alternative would be the collection of the fees through a general tax by the individual county, which would in turn reimburse the refuse collection agency.

Some of the Coastal Zone areas have such low population densities that regular refuse collection service would be infeasible economically. For those areas, a refuse transfer system might be employed whereby large metal bin-type containers, strategically located throughout a county would be available as a place for the local residents to dump their wastes instead of the original open dump. The contents would be removed routinely to the remote regional landfill for disposal.

Solid Waste Disposal

Considerable emphasis will be placed in the future on reclamation and conversion of wastes to useful materials. A transition stage will be required to perfect these future processes, and hence large-scale solid waste reclamation systems probably will not be available for another ten years. Land disposal will therefore continue to be the dominant disposal system throughout Califoria during this interim period. The trends toward regionalization of disposal sites resulting in the reduction of the number of sites are expected to continue. Therefore, future landfills will be of larger capacity. Specialized equipment will be used more extensively to increase the efficiency and effectiveness of landfill operations. Future landfill practices may also provide for preprocessing of the wastes to a greater extent by baling, grinding, or stablization prior to disposal in a landfill. In recognition of the hazards of methane gas migrating from landfills, gas control systems may become a standard item in most landfills.

As stated earlier, few solid waste disposal sites now exist in the Coastal Zone. Many of these sites will face closure in the future either because of the unsuitability of the present locations for improved operating practices or because of the exhaustion of disposal capacity. The future regional sites serving the Coastal Zone are expected to be located further inland to canyons leading to the sea. This will occur since the seacoast lands do not readily lend themselves to good landfilling conditions, and because other competing land uses will probably be desired.

It is expected that future disposal sites will be developed in a county following the county general solid waste disposal plans, and the coastal areas will be served by regional sites. Since much of the Coastal Zone has restricted transportation capabilities, these regional sites may be cooperative ventures between several counties. To operate these sites efficiently, an interrelated system will have to be established either as a county function or by private enterprise. These sites will call for a greater investment in order to satisfy the requirements of improved operating practices.

Transfer stations will be used to a greater extent in the major metropolitan areas as the disposal sites serving these areas are located greater distances from the centers of waste production. A recent example of this is the City of San Francisco where refuse is trucked over 30 miles to the City of Mountain View where a landfill operation is being used to develop a regional park. Transport via railroads may also be used in the future, thereby

utilizing long-distance hauling (over 200 miles) to far distant disposal sites. As an example of future conceivable changes in the technology of this field, pipeline systems may evolve as another possible long-distance transfer method--either slurry pumping or pneumatic transport.

Although the landfill procedure is expected to be generally phased out in the coastal strip in preference to more favorable inland locations, landfills might however be employed to advantage along the Coastal Zone where modification of the natural terrain is desired. Special fill projects could effectively use refuse and other solid wastes with a twofold purpose--inexpensive fill material and a point of refuse disposal. These special landfills would require construction techniques that adhere to rigid standards so that environmental health concerns are controlled during the operation of the site, and so that long-term stability of the fill and water pollution control are realized. In the urbanized areas, the protected tidelands and marshlands will continue to face increasing pressure of proposed fill projects. Some of these fill projects might use solid wastes as a fill material to good benefit.

Solid Waste Processing and Reclamation

There is a growing interest in solid waste processing systems other than land disposal. This will be accelerated with the increasing cost of transportation and land. Because of the concern for air pollution control in California and the high cost of emission control equipment, it is envisioned that the area of greatest application of incineration for the next decade will be specialized on-site incinerators serving high volume waste producers. The long-

range future of incineration will rest on the various possible refinements to ensure more complete combustion, to make use of the heat, and to reduce or eliminate the air pollution problem associated with combustion products. Processing methods such as pyrolysis, wet oxidation, and composting will be applied to certain wastes.

The ocean will continue to be viewed as a giant sink for waste disposal. But, greater scrutiny will probably be made before the disposal of waste occurs. Presently, no refuse from municipal sources in California is disposed of at sea. It appears that federal regulations will prohibit new and existing solid waste disposal to the ocean until careful investigation evaluates the effect on the ocean environment.

Long-range solutions to the solid waste problems will emphasize recovery of the resources inherent in discarded materials. To achieve this, future decisions must reflect a more enlightened position than the present concept of disposal of solid wastes as pollutants. Solid wastes will be viewed in terms of their resources value. This will result in a reduction of the quantities of wastes, at the same time conserving our natural resources. Waste reclamation techniques will also be stimulated by the tightening of environmental protection regulations. For example, as regulations controlling air pollutants become more stringent, the forest products industries will recover a greater percentage of the harvested timber. Already, today, many conical burners have been shut down and chipping machines have taken their place preparing a marketable by-product out of what was formerly a waste material. Although most of the Coastal Zone has a limited amount of industry and agriculture within its designated boundaries, the wastes generated from these sources in

adjacent areas will be controlled to a greater degree in the future. Long-range developments may turn cull fruit and vegetables into composted soil amendment materials, and cattle and poultry manure into protein sources for animal foods.

RECOMMENDED POLICIES

Existing policies for solid waste management at State and local levels are inadequate. Efforts are now being made to implement a program of action by the State to coordinate State, local and private solid waste responsibilities. The objective of that program is to assure the protection of public health and environment quality while conserving the State's resources.

It is anticipated that local agencies will continue to be charged with responsibility for local policy promulgation and administration, as well as for detailed planning, regulation and surveillance of local solid waste programs, and for operation of the solid waste handling systems. Action at the local level should be consistent with the policies and standards which will be established by the State

In the Coastal Zone, plans for solid waste management practices should be developed as a portion of the total county or regional solid waste plan. This will be necessary since most of the disposal sites will be located out of the Coastal Zone, and the input of wastes from the Coastal Zone to other inland portions of a county must be acknowledged. Any planning effort should be comprehensive, considering all wastes produced and involving cooperative efforts between the various jurisdictions concerned. Implementation of

the plans will require enactment of new local ordinances in many areas. These ordinances should not be in conflict with any minimum standards established by the State, but might be more restrictive and comprehensive if indicated by local problems and conditions. Surveillance of operating practices and enforcement of the standards must be upgraded at the local government level if existing environmental problems associated with solid waste disposal are to be abated.

PART 2

A

HYDROLOGIC ASPECTS OF THE COASTAL ZONE

The scope of this appendix is to present a regional picture of water supply, water demand and flood control as they relate to the coastal zone. The material has certain limitations because of the generalized approach taken in its preparation. The Department of Water Resources urges persons seeking water related information to refer directly to published bulletins cited in the bibliography included at the end of this material.

Water Supplies

Water supplies available to the coastal zone vary widely from location to location. Although shortages of fresh water exist in localized areas of the coastal zone, water is not a major factor in the comprehensive ocean area planning because several alternatives are available for water supplies.

In the northern half of California, surface water supplies can usually be developed from conventional water supply projects, usually within a few miles of the area of demand. The only major deterrent in its development is the test of economic justification and financial feasibility of the project.

In the southern half of the state, surface water sources are less plentiful and demands are supplied primarily from importation of water through existing water supply systems.

Surface water is the prime water source to supply the coastal zone. However, supplemental and standby supplies could be obtained from ground water, desalting, waste water reclamation

and weather modification. Each of these sources of water will be discussed on a statewide basis.

Surface Water

The following table gives the estimated average annual natural runoff of the major coastal streams. These runoff figures indicate the relative size of these selected streams, but do not give a true indication of the relative potential of the streams as a water supply. Most coastal streams are characterized by surpluses of water during the winter runoff season and shortages of water to supply demands during the summer season.

The water supply potential will be discussed later under the heading "Comparison of Water Demand and Water Supply".

Estimated Average Annual Natural Runoff
1931-60 (in 1,000 AF)

By region:	Amount
North Coastal (in California)	27,060
San Francisco Bay, including Russian River	3,350
Central Coastal	1,780
South Coastal	1,400

By Selected Stream:

North Coastal region	
Smith River near Crescent City*	2,680
Klamath River near Klamath*	12,650
Redwood Creek at Orick	710
Mad River near Arcata	1,040
Eel River at Scotia	5,470
Navarro River near Navarro	350
San Francisco Bay region	
Russian River near Guerneville	1,360
Petaluma River at Petaluma	10
Sonoma Creek at Boyes Hot Springs	44
Napa River near St. Helena	62
Walnut Creek at Walnut Creek	17
San Lorenzo Creek at Haywood	10
Alameda Creek near Niles	107
Coyote Creek near Madrone	49
Guadalupe River at San Jose	35
San Francisquito Creek at Stanford University	16
Pescadero Creek near Pescadero	31
Central Coastal region	
San Lorenzo River at Big Trees	94
San Benito River near Hollister	38
Uvas Creek near Morgan Hill	25
Arroyo Seco near Soledad	111
Salinas River near Bradley	325
Big Sur River near Big Sur	64
Arroyo Grande at Arroyo Grande	16
Cuyama River near Santa Marin	15
Sisquoc River near Sisquoc	30
San Jose Creek near Goleta	1

*Includes some water originating in Oregon

South Coastal region

Coyote Creek near Ventura	10
Sespe Creek near Fillmore	76
Topanga Creek near Topanga Beach	4
San Gabriel River near Azusa	102
Santa Ana River near Mentone	50
San Luis Rey River at Lake Henshaw	20

Ground Water

Ground water in the coastal segment of the 15 counties facing the Pacific Ocean is stored in 262 ground water basins. Most of the 262 basins are small valley-fill areas less than 5 square miles in extent, shallow in depth, limited in their storage capacity to hold water, and generally yielding small quantities of water to wells except where coarse sand and gravel aquifers are encountered near the base of the valley-fill. Alluvium in all of these small valleys is probably in direct contact with sea water. Development of large yielding wells within 1/4 to 1/2 mile of the coast may rapidly cause degracation of the quality of the ground water because with limited storage capacity of the basin water levels rapidly drawndown causing the normal seaward hydrualic gradient to be reversed thus bringing salt water in from offshore extension of the aquifers.

Large coastal ground water basins occur in Humboldt, Santa Cruz, Monterey, Santa Barbara, Ventura, Los Angeles, and Orange Counties. These large basins have been pumped for many years and several of the basins (Salinas Valley and the Coastal Plain of Los Angeles and Orange Counties) have well established patterns of sea water intrusion. In the Coastal Plain of Los Angeles County, a water injection barrier system to control sea water intrusion is operating satisfactorily. Small segments of the Coastal Plain of Orange County have experimental trough and treated water injection systems in operation or planned. Studies are currently underway in the Santa Clara River Valley of Ventura County, and the Salinas Valley of Monterey County, to develop plans to alleviate sea water intrusion.

If these large ground water basins are managed in conjunction with other water supplies large amounts of ground water of good quality can be maintained in storage and large yielding wells can be developed in most areas of the basins. Most of the basins have permeable recharge areas, highly transmissive aquifer systems, and thus are ideally designed for conjunctive operation of surface and ground water. Several of the basins, Salinas Valley, Pismo-Santa Maria Area, Santa Clara River Valley, and Coastal Plain Orange County may have extensive offshore aquifers filled in part with fresh water.

Desalting

Desalted sea water offers promise of becoming a supplemental source of fresh water in certain areas of California, particularly in the Central and South Coastal areas, where alternative sources of supply are costly. Desalination could eventually reduce the need for additional imports of fresh water and could also be used to desalt mineralized waste water.

With present day technology existing or planned small coastal communities could be provided with a supply of high-quality desalted water from commercially available desalting apparatus.

Perhaps another 20 to 30 years will be required before desalting technology is sufficiently improved to include desalination as a significant source of water supply. However, the prospects for large-scale desalting as an alternative source of water in California are sufficiently promising to warrant additional research and development.

Water Reclamation

The reclamation and reuse of waste water presents a potential source of additional water supply in coastal metropolitan areas. In addition to providing a supplementary source of fresh water, reclamation reduces the amount of water that must be discharged, thus lowering the total costs of waste disposal. However, the increased use of reclaimed water would not eliminate the need for additional supplies of fresh water. About 50 percent of the total water supply in a given community is consumed and is therefore unavailable for reclamation. Furthermore, only a portion of the total waste water discharged can be reclaimed. In general, the percentage that can be reclaimed is limited by (1) the quality of the waste water, (2) the cost of treatment, and (3) the cost of conveyance and distribution of the reclaimed water to areas of use.

The direct use of reclaimed water for domestic needs is limited by reservations concerning the certainty of detecting and eliminating virus and other disease agents from waste water. Nitrogen content is another limiting factor. For the present, therefore, the use of reclaimed water will probably continue to be restricted to irrigation, artificial lakes and ground water recharge.

Weather Modification

Precipitation augmentations by means of weather mofification will not provide a basic water supply. With rare exception, water development systems will be required to collect, control, and distribute the increased precipitation resulting from weather modification.

The greatest potential for weather modification which may affect water supply in the coastal zone will be in the coastal mountains, inland from the coastal strip. These areas provide greater opportunity to seed, without objections, because of fewer people and more prevalant occurrence of control and storage facilities downstream. The coastal drainage basins south of San Francisco Bay will be more amenable to the use of weather modification from the two standpoints (1) general need, and (2) the existance of control, storage and distribution systems.

Average increases in the range of five to fifteen percent of the natural precipitation may result from weather modification. The amount of usable water that can be salvaged from precipitation increases depends upon many factors, such as the rainfall-runoff relationship, the existance and location of storage facilities, etc.

Recovery of water in the fog belt by means of "fog drip" does not appear to be a major source for future water supply. Such recovery may be useful for local application, such as irrigation of gardens, in areas where collection systems do not impose esthetic problems.

In the future, greater control over the areas affected and greater increases from weather moiification might be anticipated. In the distant future, amelioration of floods from some storms may be possible by cloud seeding over the ocean before the storm reaches the mainland.

Comparison of Water Demand and Water Supply

Information on the estimated water demand and the potential water supply in each hydrologic area of the State is presented in Bulletin No. 160 series of the Department of Water Resources. The last report is Bulletin 160-70, dated December 1970. The hydrologic study areas used in this report are shown in Figure 4. Information for each hydrologic study area along the coast, based on information compiled in the preparation of that report, is summarized as follows:

North Coastal Area

The North Coastal region comprises three counties, Del Norte, Humboldt, and Mendocino. It is an area of rugged generally forested mountains, striking coastal scenery, and many redwood groves. Major streams include the Smith, Klamath, Mad, Eel, Mattole, and Navarro Rivers.

Estimated Water Demands

The North Coastal area has always been somewhat isolated from the rest of California because of the mountains. Lumbering and wood products are prime industries, with recreation and agriculture also important. Most of the farming occurs on the coastal delta flood plains of the Eel River

HYDROLOGIC STUDY AREAS OF CALIFORNIA

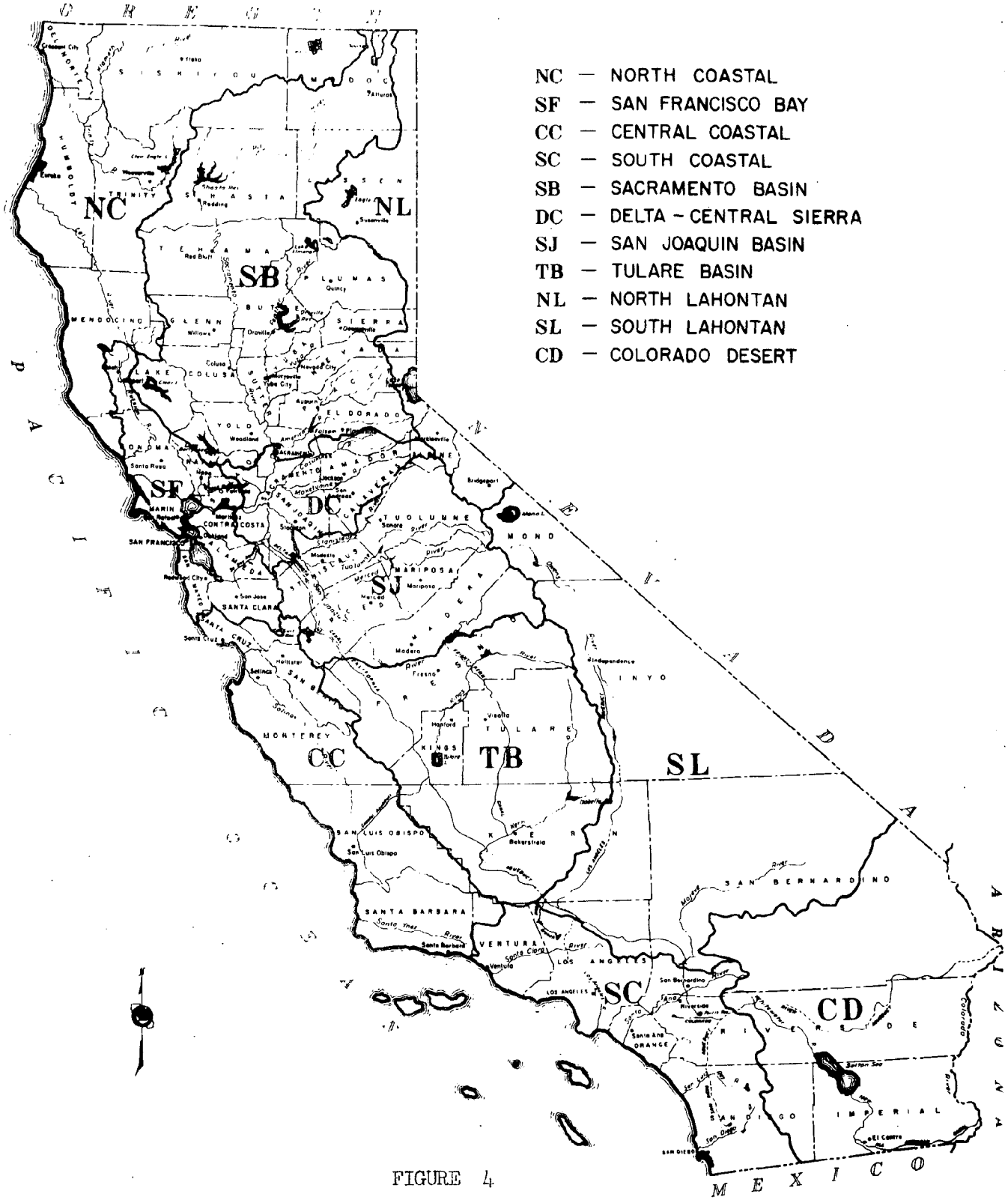

FIGURE 4

near Eureka, the Smith River near Crescent City, and several interior mountain valleys, especially the Upper Russian River drainage in interior Mendocino County.

The major industrial use of water is the paper pulp industry. Recently two large pulp mills have located near Eureka and are converting formerly wasted by-products of the lumbering industry into pulp. The present water requirements of these two plants are estimated to be about 60,000 acre-feet annually. Industrial demands for the pulp mills in Humboldt County will probably double by 1990 to 120,000 acre-feet per year. Under present forest practices in Humboldt and adjacent counties the availability of raw wood material could prove to be the limiting factor in expansion of the pulp industry.

Municipal and agricultural water demands are expected to increase slowly over today's levels because relatively small population increases and limited local demand for farm products are predicted. The isolation of many of the farming areas from other potential markets will inhibit agricultural expansion.

Estimated and projected water demands by category and by county are as follows, in 1,000 acre-feet:

Category	1967	1990	2020
Pulp and Paper	60	120	160
Municipal & Other Industrial	30	40	70
Agricultural	90	110	120
Total	180	270	350
County (Unrounded)			
Del Norte	10	14	17
Humboldt	115	188	206
Mendocino Coastal	7	13	60
Mendocino Interior	47	60	68
Total	179	275	351

Estimated Water Supply

The available water supplies for 2020 demands are estimated to be as follows, in 1,000 acre-feet:

Area	Surface	Ground Water	Total
Del Norte County*	9	8	17
Humboldt			
North Humboldt subunit	2	1	3
Mad River subunit	90	13	102
Eel River	6	38	44
Mattole-Bear Rivers subunit	3	-	3
County Total	101	52	153

*Almost all is in the Smith River hydrographic unit, only about 300 acre-feet is in the Klamath River area. The supply shown matches estimated 2020 demand; more water is potentially available from present sources.

Area	Surface	Ground Water	Total
Mendocino			
Mendocino Coast subunit	4	1	5
Little Lake Valley subunit	-	15	15
Upper Eel subunit	0	23	23
Redwood Valley subunit	0	1	1
Russian River subunit	24	15	39
County total	28	55	83

The deficits between projected demand and water supply, according to the DWR Ten County Investigation are as follows:

Area	1990	2020
Humboldt County		
Mad River subunit, County total	46	53
Mendocino County		
Mendocino Coast subunit	8	55
Redwood Valley subunit	5	6
Russian River subunit	3	8
County total	16	69

Many of the small communities in the region have problems with their water supplies, such as dry season shortages, contamination, high iron and manganese concentration, ground water pollution, and inadequate distribution systems. Some salinity intrusion of alluvium ground water has been observed in the Eel River delta. There is also a USBR report of some salt water contamination of ground water along the north edge of Arcata Bay and adjacent to Mad River Slough.

The authorized federal Butler Valley Project on the Mad River would have sufficient capacity to meet the foreseeable Mad River-Eureka area water needs. New supplies are needed in the Mendocino Coast area also. A number of potential reservoir sites exist on Mendocino coastal streams, but no definite development proposals are known at this time. Inland areas of Mendocino County in the Russian River drainage area also will require new water supplies. The most favorable sources are the

enlargement of existing Lake Mendocino, English Ridge reservoir on the Eel River, or other Eel River developments.

North San Francisco Bay

This area consists of Sonoma and Marin Counties. The economy is a combination of industry and agriculture. Eastern Marin County is primarily a bedroom suburb of San Francisco. County master plans are built around the concept of preserving the western portions of Marin County in a rural or recreation setting and confining most urban growth to the eastern third of the County. Major military installations include Hamilton Air Force Base and the army forts on the north side of the Golden Gate.

Agriculture is important further north, particularly in the Russian River area, where orchards and vineyards are prominent. The Petaluma area was once famous for its egg and poultry production, but in recent years this industry has shifted to other areas of the State.

Estimated Water Demands

The estimated demands for applied water are as follows, in 1,000 AF per year:

Category	Water Demand		
	1967	1990	2020
Municipal and industrial	73	155	296
Agriculture	76	95	123
TOTAL	149	250	419
County			
Marin	35	69	112
Sonoma-Gualala River Subunit	--	1	2
Sonoma-Santa Rosa-Petulama subunit	114	180	305
TOTAL	149	250	419

Estimated Water Supply

In general, a fairly generous supply of water exists in the North Bay Area. But, as elsewhere in the State, it must be regulated to be available to meet demands. Some natural regulation is provided by ground water basins; the balance must be provided by artificial means. Often imported supplies from the areas with water surplus are cheaper than developing local streams. A major import to the North Bay area in the Potter Valley diversion from the Eel River, which diverts an average of about 170,000 AF per year into the Russian River basin. This import supply is re-regulated by lake Mendocino to furnish downstream water users. The Warm Springs project on Dry Creek is in the preliminary stages of construction by the U. S. Corps of Engineers; it would provide just over 113,000 AF of new supply for Sonoma and Marin Counties. When Warm Springs dam and the proposed Sonoma County distribution systems are complete, the water supply for each county would be as follows:

Area	Surface	Ground Water	Reuse	Total
Marin County	42	1	--	43
Sonoma County-Gualala River Subunit	2	--	--	2
Sonoma County-Santa Rosa-Petulama Subunit	123	30	23	176
TOTAL	167	31	23	221

Indicated future deficiencies in water supply would be:

County	1990	2020
Marin	26	69
Sonoma	4	129

If Marin County does participate in the Sonoma Marin Aqueduct, their supply would be increased by 47,000 AF to about 90,000 AF per year; the additional Warm Springs Reservoir supply, on a county wide basis, would meet expected water demands beyond the year 2000.

Possible new sources of water supply after about 1990 for Russian River service areas include two small local projects, additional Russian River basin reservoirs, the authorized Knights Valley Project, waste water reclamation, particularly in the Santa Rosa area, and new imports from the Eel River or the Central Valley Basin.

South Bay Area

The South Bay Area is the drainage basin of the streams which discharge into the southern side of the San Francisco Bay estuary westward from Chipps Islands Strait, near Pittsburg. On the ocean side of San Francisco Peninsula, the area extends to approximately the southern San Mateo County line.

Estimated Water Demands

The South Bay Area ranks second only to the South Coastal Area in growth. It is already highly urbanized and will become more so as population doubles between now and 2020. It is primarily a commercial, trade, and industrial region today, although agriculture is still important in Santa Clara and eastern Alameda counties.

Estimated present and projected future applied fresh water demand is as follows:

	1967	1990	2020
Agriculture	170	70	10
Municipal and Industrial	700	1170	1920
Total	870	1240	1930

An approximate county breakdown of total water demand is listed in the following tabulation. The amounts are only for the portion of the county within the South Bay area; substantial portions of Contra Costa, Alameda, and Santa Clara Counties lie in other hydrographic provinces.

County	Estimated Water Demand 1967	1990	2020
San Francisco	110 TAF	120 TAF	140 TAF
San Mateo	100	150	200
Santa Clara	290	420	690
Alameda	210	250	430
Contra Costa	160	300	470
Total	870	1240	1930

Estimated Water Supply

Local surface and ground water supplies have been almost fully developed and the area depends heavily on imported supplies. Estimated amounts which could be provided from works existing or under construction in 1990 and in 2020 are as follows:

Source	1990	2020
Local surface sources	80 TAF	80 TAF
Ground Water, safe yield	250	250
Mokelumne Aqueduct, EBMUD	360	360
Hetch Hetchy Aqueduct, City of S.F.	330	450
Contra Costa Canal	140	140
South Bay Aqueduct	160	190
San Felipe Division, CVP	60	170
Folsom South Canal, EBMUD	20	150
Waste Water Reclamation	10	10
Total	1410	1800

The ground water estimate includes water first conserved behind dams in Santa Clara County and then subsequently released to percolate to ground water basins.

There is a large accumulated overdraft on ground water in northern Santa Clara County which has caused ground subsidence in the past. Currently new water supplies from the SWP and Hetch Hetchy Aqueduct have arrested the decline in ground water levels on an area-wide basis, projected supplies appear more than adequate in 1990. By 2020 a supplemental demand of 130,000 AF is indicated. However, supplies seldom exactly match demands in any given service area and the degree of future transfer possible is only conjectural; therefore, future deficits will probably be larger than indicated herein.

Future sources would have to be primarily new imports, waste water reclamation, or possibly desalting. The only significant undeveloped local supplies are on the ocean side of San Mateo County where several potential small storage projects are possible.

Central Coastal Area-Northern Portion

The northern portion of the Central coastal hydrographic study area extends from approximately the north border of Santa Cruz County to the southern border of Monterey County. It extends inland to the crest of the Coast Range and includes all of Monterey County, practically all of Santa Cruz County, most of San Benito County, and the southern portion of Santa Clara County. It is a region of beautiful coastline scenery, beaches, pleasant inland valleys, and, in places, rugged mountains.

Estimated Water Demands

The major urban centers are situated in the Monterey Bay area. There is some industry, but the military and recreation (including tourists) factors strongly influence the urban economy. Agriculture is important, especially in the Salinas Valley and Pajaro River drainage. This area is a primary year round truck crop area.

Estimated demands for applied water are as follows:

	1967	1990	2020
Agricultural	690 TAF	790 TAF	860 TAF
Municipal and industrial	90	160	280
Total	780	950	1140

About 3/4 of the agricultural water demand is in the Salinas Valley of Monterey County. This proportion is expected to continue in the future.

Urban demands in the south Santa Clara-Hollister area account for about 15% of the total demand today, but this fraction is expected to increase in the future because of more rapid projected urban expansion there. (This assumes a continuation of present urban growth trends, with no substantial effective alteration by government policy or regulation.)

Estimated Water Supply

Most water supplies in the northern portion of the Central Coastal hydrographic study area are taken from ground water pumping. The bulk of the ground water recharge is from natural sources, but substantial additions to natural recharge have been achieved by storing winter flood surpluses in reservoirs

and releasing the water more gradually down the stream channel so that it can percolate to ground water. Reservoirs which are operated this way include Nacimiento and San Antonio on the Salinas River basin, and Uvas, Chesbro, Pacheco, and Hernandez in the south Santa Clara-Hollister area. The combined yield of these six reservoirs for ground water recharge is about 130,000 AF. (In addition, there is a 17,500 AF reserve supply for San Luis Obispo County at Nacimiento Reservoir.) Estimated diversions from other surface sources are around 30,000 AF, primarily from the Carmel River and Santa Cruz County streams. The San Felipe Division of the CVP is expected to begin delivering imported water to the Pajaro River basin by about 1980.

Estimated present or firmly committed water supplies are as follows:

Local surface sources	30 TAF
Surface reservoirs used for ground water recharge	130
Ground water, safe yield	410
San Felipe Division, CVP	110
Reuse, at present levels	120
Total	800

Excluding the San Felipe Division, which is not completed, present supplies are about 690,000 AF which is 90,000 AF short of current water demands. This deficit is being made up from ground water overdraft with resulting water quality problems, especially sea water intrusion, in some areas.

Even with full San Felipe Division imports, large deficits are indicated for 1990 and 2020. A small amount of

additional ground water potential exists in several areas, probably aggregating about 20,000 AF. Potential local reservoirs, mainly in Monterey County, could possibly develop another 100,000 to 150,000 AF of new yield. Incidental reuse in 2020 may increase some 70,000 AF. But, all indications are that the forecast level of demands beyond 1990 will outstrip existing, committed, and potential conventional local sources. Sources of new supply could be imports, desalting, or waste water reclamation at that time. The major area of forecast future deficits is in the lower Salinas Valley, which is vulnerable to sea water intrusion.

Central Coastal Area - Southern Portion

The southern portion of the Central Coastal hydrographic study area extends from the Monterey-San Luis Obispo County line on the north to the Santa Barbara-Ventura County line on the south along the coast and to the crest of the coast ranges on the east. It includes Santa Barbara County, practically all of San Luis Obispo County, and the upper Cuyama River drainage in northwestern Ventura County.

Estimated Water Demands

Agriculture was the mainstay of the area's economy until the early 1940s and still is in San Luis Obispo County. Since World War II, however, the area has been changing to a more urban character, particularly the south coastal strip of Santa Barbara County and near military bases such as Vandenberg AFB. The establishment of state institutions such as Cal Poly and UCSB and the California Men's Colony also have influenced the nature of the urban growth.

Estimated and projected applied water demands are:

Agriculture	340 TAF	390 TAF	400 TAF
Municipal and industrial	80	120	230
Total	420	510	630

Total demand for applied water by county is:

San Luis Obispo County	170	200	270
Santa Barbara County	250	310	360
Total	420	510	630

Many of the flatter lands near the coast are well suited to vegetable and flower crops. The south coastal strip of Santa Barbara County also has many citrus groves which are gradually succumbing to urban expansion.

Estimated Water Supply

Most of the water used in the two counties is pumped from wells. Most of the ground water is from natural sources, but some is derived from recharge operations of several reservoirs, notably Twitchell Reservoir.

Estimated present and contracted water supplies are as follows:

San Luis Obispo County

Salinas, Whale Rock, & Lopez Reservoirs	21 TAF
Twitchell Reservoir, County share	5
Ground Water, safe yield	79
SWP, contract amount	25
Reuse, present level	67
County Total	197

Santa Barbara County

Jameson, Gibraltar, & Cachuma Reservoirs	33
Twitchell Reservoir, County share	16
Ground Water, safe yield	110
SWP, contract amount	58
Reuse, present level	68
County Total	285
GRAND TOTAL	482

Excluding the SWP, present supplies are about 400,000 acre-feet, 172,000 acre-feet in San Luis Obispo County and 227,000 acre-feet in Santa Barbara County. These figures partly obscure present ground water overdrafts of about 17,000 acre-feet in inland San Luis Obispo County and 20,000 acre-feet in Santa Barbara County. Other individual communities along the coast may have water supply, quality, or distribution problems not apparent on a broad-scale look such as this.

By year 2020 reuse is estimated to increase about 30,000 acre-feet. Assuming the SWP in service, supplemental demands would be about 10,000 acre-feet in 1990 and 120,000 acre-feet in 2020. Future sources could include new import supplies; new surface development, especially in northern San Luis Obispo County; desalting; ground water "mining" of fresh water; and possibly a small amount of waste water reclamation. As for surface supplies, San Luis Obispo County has rights to 17,500 acre-feet of Nacimiento Reservoir yield, but does not have the conveyance works to take that water to areas of present or projected future need. New reservoir projects have been proposed for Santa Rita, Jack, Santa Rosa, San Simeon, Arroyo de la Cruz, and San Carpojo Creeks in northern San Luis Obispo County. In Santa Barbara County new dams have been proposed at the Round Corral site on the Sisquoc River and the Lompoc site on the Santa Ynes River. The Department of Water Resources is making a study of a large scale experimental desalter in conjunction with the Diablo Canyon nuclear power plant.

South Coastal Area

The South Coastal Area comprises the drainage area of the streams emptying into the Pacific Ocean from the Santa Barbara-Ventura County line on the north to the Mexican border on the south. It is the most populous area of the State and a leading industrial and commercial center. Rapid growth has occurred in the past and is expected to continue in the future.

Estimated Water Demands

In the past expansion occurred in both the urban and agricultural sectors. Since around 1950, however, rapid expansion of urban areas has caused a substantial decrease in the acreage farmed. Present and projected applied water demands are as follows:

	1967	1990	2020
Agricultural	1110 TAF	820 TAF	560 TAF
Municipal and Industrial	2060	3460	5400
Total	3170	4280	5960

Agricultural demands include an allowance for double cropping, which is quite common in the coastal plain areas, especially in truck crop and flower raising. Municipal and industrial demands include a small allowance of fresh water for recreation, and fish and wildlife maintenance.

Estimated Water Supply

The area presently depends for its water supply on (1) local surface and ground water supplies, which are almost fully developed (2) the Los Angeles Aqueduct from Owens Valley,

which was enlarged in 1970 to deliver about 480,000 AF annually, and (3) the Colorado River Aqueduct now delivering water at almost its full capacity of 1,180,000 AF per year. In 1971, deliveries will begin from the State Water Project. The total maximum entitlements to Project water amount to about 2,200,000 AF per year for the South Coastal area. Delivery of full SWP entitlements would, however, require additional water development in northern California.

The water supply from the Colorado River is expected to be reduced to 520,000 AF net (allowing 30,000 AF for Aqueduct losses) in the mid 1980s when the Central Arizona Project comes into operation.

In addition to incidental reuse of applied water, a substantial amount may be made available from deliberate planned reclamation of waste water which would otherwise be discharged to the ocean. Today about 50,000 AF per year is being supplied from this source. Fairly definite plans have been made for a total of around 300,000 AF of waste water reclamation, the figure assumed herein.

Estimated present or firmly committed water supplies for the South Coastal Area are:

Local surface sources	180 TAF
Ground water, safe yield	950
Los Angeles Aqueduct	480
Colorado River Aqueduct, after C.A.P.	520
State Water Project, entitlements	2200
Waste water reclamation, future	300
Reuse, at present levels	690
	5320

Incidental reuse is expected to decline about 10,000 AF by year 2020 as agricultural acreage declines further and as urban density increases. But, it is evident that the total water supply is adequate to meet the demand for some time beyond the year 1990. The supplemental 2020 level demand of 650,000 AF could be met from desalting, additional waste water reclamation, or new imported supplies. In addition, a very small increase in local surface supply could be achieved by new or enlarged reservoirs on the Santa Margarita and San Dieguito Rivers. Projects have been proposed for Sespe Creek in Ventura County, but their immediate construction does not appear likely.

In summary, the areas north of the Russian River have adequate water supplies that can be developed by conventional water development projects to satisfy demands through 2020.

In areas south of the Russian River, area water demands are expected to exceed present supplies of water from conventional sources by year 2020; therefore, new sources or importation will be needed.

On a regional basis all areas of the coastal zone can be provided with adequate water supplies from present and proposed facilities to take care of the demands through 1990 except possibly in Monterey County.

Flood Control

Many agencies have built extensive works in California to provide flood protection. Most active in this field have been

the local flood control districts and the U. S. Army Corps of Engineers. Although much has been accomplished, the Christmas flood of 1964 in Northern California and other recent floods elsewhere in the State have demonstrated that much remains to be done. Existing and proposed flood control works for each hydrologic area of California is presented in a report entitled, "Comprehensive Framework Study Appendix IX, Flood Control".

Because of the increasingly intense use of land resources, solutions to flood problems in the coastal zone will become more urgent and critical as the population increases.

The degree to which improvements are exposed to floods varies considerably from area to area. Much of the North Coastal area is subject to staggering periodic flood damage, as evidenced by the Christmas 1964 flood. In the San Francisco Bay area, a number of flood control facilities have been built, but there are still problems to be solved. Examples of the kinds of development needing further protection are urban and agricultural improvements along the Russian and Napa Rivers and urban areas adjacent to restricted natural channels, particularly in the zones of tidal influence near the San Francisco Bay. In parts of the Central Coastal area, provision for channel improvements, bank revetment, flood control reservoirs or levees, or floodplain management will be needed as urbanization proceeds.

Considerable progress has been made by federal and local agencies in developing and implementing comprehensive flood control programs in the South Coastal area. Nevertheless, in certain areas the rate of construction of flood control works is not sufficient to keep up with the growing need.

Authorized and Proposed Flood Control Projects

Federal authorization has been obtained for a number of flood control projects which could be constructed by 1980 in the coastal basins. In addition, investigations are underway for several potential projects. These proposed and potential projects are listed by hydrologic study area in the following table.

FLOOD CONTROL PROJECTS

Name of Stream	Federally Authorized	Under Investigation	Future Potential
North Coastal Area			
Eel River Delta Area	x	-	-
Upper Eel River Development	x	-	-
Eel River	-	x	-
Klamath River	-	x	-
Mad River	-	x	-
Smith River	-	x	-
Sequoia Reservoir	x	-	-
Butler Valley Reservoir	x	-	-
San Francisco Bay Area			
Russian River	x	x	-
Warm Springs Reservoir	x	-	-
Big Sulphur Reservoir	x	-	-
Knights Valley Reservoir	x	-	-
Pescadero Creek	-	x	-
San Gregorio Creek & Tribs.	-	x	-
Central Coastal Area			
Pajaro River	x	-	-
Pajaro Valley & Basin	x	-	-
Soquel Creek	-	x	-
Arroyo Grande Creek	-	-	x
Carmel River & Tribs.	-	-	x
Salinas River	-	-	x
San Lorenzo River & Tribs.	-	-	x
South Coastal Area			
Los Angeles Drainage Area	x	-	-
Lytle & Warm Creeks	x	-	-
San Diego River	x	-	-

FLOOD CONTROL PROJECTS (CONTINUED)

Name of Stream	Federally Authorized	Under Investigation	Future Potential
South Coastal Area (Continued)			
Santa Paula Creek	x	-	-
Topatopa Reservoir	x	-	-
Tia Juana River	x	-	-
Cucamonga Creek	x	-	-
Sweetwater River	x	-	-
Deer, Day, Etiwanda & San Sevaine Creeks	-	x	-
San Dieguito River	-	x	-
San Luis Rey River	x	-	-
Santa Ana River Basin	-	x	-
Santa Barbara County Streams	-	x	-
Santa Clara River	-	x	-
University Wash & Spring Brook	x	-	-
Upper Warm Creek	-	x	-
Laguna Canyon	-	-	x
San Ynez River & Tribs.	-	-	x
Switzer Creek	-	-	x

Flood Plain Management

Land use and controls are rapidly becoming an accepted means for reducing damage caused by floods. Traditional approaches of constructing expensive flood control projects may not be the best alternative for flood control. Concepts for reducing flood damage should consider various combinations of structures and non-structural measures according to local situations. In order to accomplish flood plain management objectives, county and city governments must adopt and police regulations and ordinances to control development in floodways and adjacent flood plains and allow only uses that are compatible with periodic flooding.

In California the Department of Water Resources has been delegated the responsibility for coordinating federal and

state programs to accomplish flood plain management objectives. These programs include: (1) the administration of the Cobey-Alquist Flood Plain Management Act; (2) the Corps of Engineers flood plain management services program; and (3) the National Flood Insurance Program.

Under the Cobey-Alquist Flood Plain Management Act, the Department of Water Resources or The Reclamation Board reviews proposed flood plain management regulations and prescribes the criteria that must be met by appropriate local agencies as a condition to receiving state financial assistance for flood control project rights-of-way costs.

The flood plain management services program of the corps of Engineers plays a significant supporting role in the effort to reduce flood damage. Its objective is comprehensive flood damage prevention planning that encourages and guides the wise and beneficial use of the nation's flood plain areas.

The National Flood Insurance Program is another flood plain management tool. This program was implemented by the National Insurance Act of 1968. It is a cooperative effort between the Federal Government and the private insurance industry. Under the program, flood insurance and mudslide insurance can be made available to individuals through private insurance agents in flood zones and coastal mudslide areas if the local governments agree to regulate future land uses. Under the present program coverage is limited to one to four unit residential dwellings and small businesses.

The broadest practical approach to flood control must be taken. Flood plain zoning is seldom sufficient by itself. Studies should be comprehensive and should give balanced consideration to all feasible means of flood control and prevention of flood damage including storage facilities, levee and stream improvements, bypass channels, zoning systems and watershed and flood plain management.

Planning for land uses in the coastal zone should consider the following objectives:

1. Constrict the development of land which is exposed to flood damage where appropriate;

2. Guide the development of proposed construction away from locations which are threatened by flood hazards.

3. Improve long-range management of flood-prone areas.

4. Consider combinations of flood control structures with land use controls in future flood control projects.

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PART 2

B

Water Quality Control

The State Water Resources Control Board and the nine regional water quality control boards protect the quality of coastal waters by regulating the disposal of wastes into the ocean or its tributaries. The Porter-Cologne Water Quality Control Act provides the basic authority for this control. The State Board guides the nine California Regional Water Quality Control Boards so that state policy for water quality control can be administered regionally, yet within a framework of statewide coordination and policy. The regional boards formulate water quality control plans for State Board approval, establish and enforce waste discharge requirements and implement policies.

The quality of coastal waters is generally satisfactory except in localized areas of poor circulation where dispersal of wastes is limited and the degree of waste treatment is not adequate. Water quality and the use of coastal waters may be threatened or impaired by the discharge of municipal wastes, various types of industrial wastes, solid wastes either dumped directly into the ocean or utilized as landfill, dredge spoil, petroleum products, wastes discharged from vessels and tributary inflows of poor quality.

A. MUNICIPAL AND INDUSTRIAL WASTE CONTROL

The discharge of municipal wastes is a problem of primary importance because of the large volume at existing outfalls and the predicted increase in population in the coastal zone. The immediate problem is to upgrade the efficiency and treatment of municipal systems where water quality is being degraded, consolidate systems being planned so that collection, treatment and

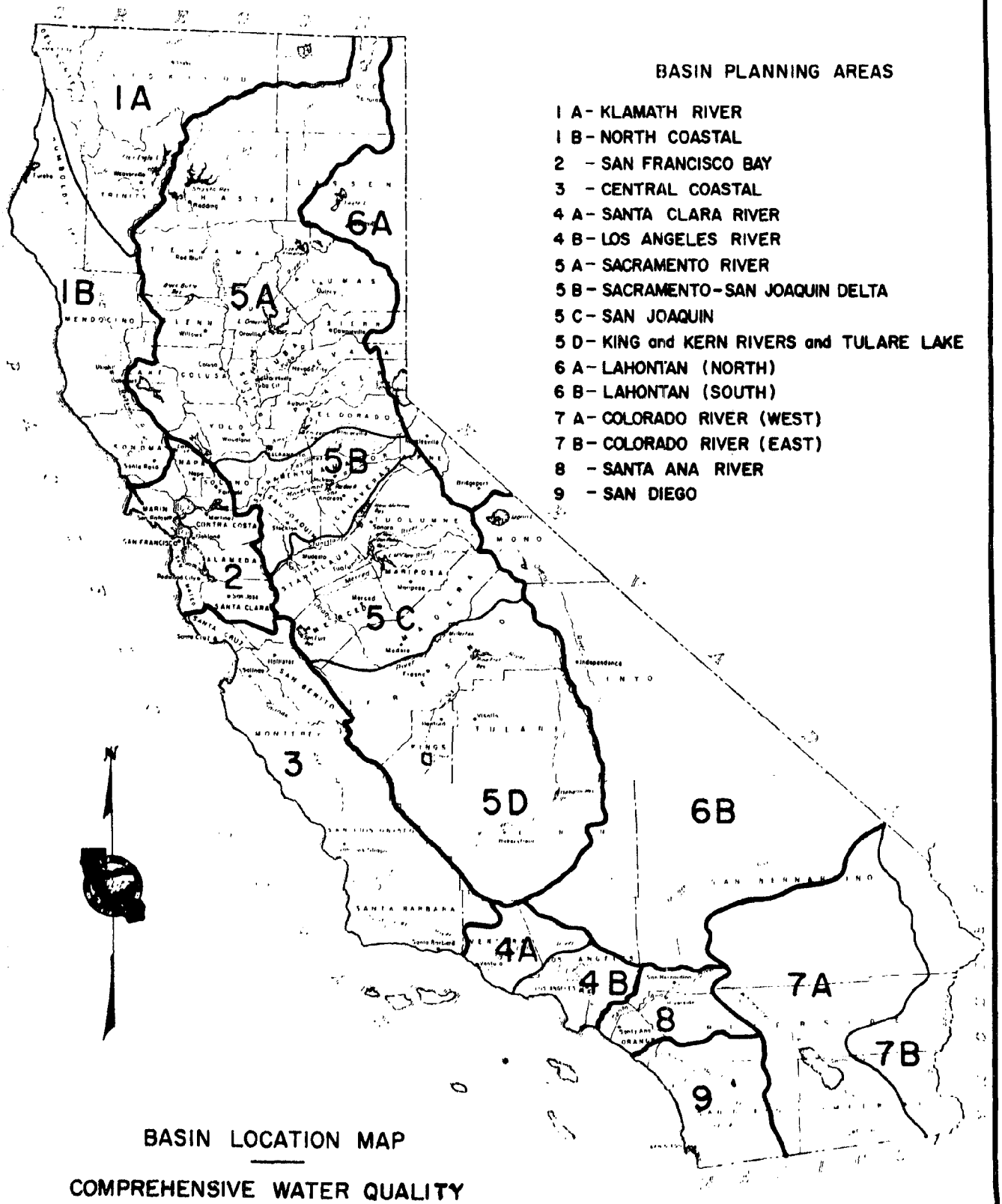
disposal of wastes can be accomplished at minimum cost, and provide adequate reserve capacity for future expansion.

To assist local governments to correct and avoid pollution of California waters, the Clean Water Bond Law of 1970 authorized a cooperative state-federal grant program for construction of waste treatment facilities. This program is administered by the State Board in accordance with regulations which require that facilities to be approved for grant aid must be compatible with applicable water quality control plans.

Interim plans have been approved for 16 basins in the State (see map). The plans will establish priorities and time schedules for upgrading and expansion of existing wastewater treatment facilities and construction of new facilities required for the next two years.

Each interim plan:

1. Determines current beneficial uses of water within each plan area and project future beneficial uses.
2. Defines uses that must be protected and set forth conditions to be maintained or developed to ensure that protection.
3. Describes municipal and industrial waste facilities needed to enable water quality criteria to be met and list projects required for water quality control during the next five years, emphasizing reclamation and reuse where feasible.
4. Includes a Conceptual Wastewater Management Facilities Plan for the next five to thirty years.



BASIN LOCATION MAP

COMPREHENSIVE WATER QUALITY CONTROL PLANS

Fully developed basin plans, to be completed by mid-1973, will elaborate on the Conceptual Wastewater Management Facilities Plans, stress economic feasibility, recommend specific water quality surveillance programs and provide overall expansion and indepth study on the concepts expressed in the interim plans. In formulating the fully developed plans, water quality-quantity relationships and land use as they affect water quality are being considered. Present and future demand on the natural water supply within a basin, both for inbasin use and for export, are being analyzed. Determination of the need for storage of water within impoundments for downstream water quality and environmental control may be an intrinsic part of a plan.

The State Board is currently developing a policy for water quality control and the discharge of municipal and industrial wastes to ocean waters as the basis for: (1) decisions in the establishment of water quality control plans, (2) adoption of waste discharge requirements, and (3) approval of applications for state and federal grants for construction of sewage facilities. The policy will assure continued application of the latest knowledge in environmental protection and waste management.

Policies were previously adopted by the State and Regional Boards in 1967 as a guide to the development of waste discharge requirements and the maintenance of water quality in accordance with stated objectives. These policies were adopted in part by the Federal Government as federal water quality standards for the coastal and interstate waters pursuant to the Federal Water Quality Control Act of 1965. The completed basin plans will incorporate the most recent policies of the State and Regional Boards for management of water quality and supersede all previous policies.

It is anticipated that the completed plans will also be adopted as federal water quality control standards.

B. TEMPERATURE CONTROL OF HEATED WASTE DISCHARGES

The State Board has adopted a specific policy for the control of wastes discharged at a temperature higher than that of the receiving water. Such wastes may be discharged by power generating plants, refineries and other types of industries and municipalities. The "Policy Regarding the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California" is currently being considered for adoption by the Federal Government.

C. SOLID WASTE DISPOSAL

The volume of solid wastes is increasing rapidly and the potential hazard to ocean resources and human health is becoming more serious. Solid wastes reach the ocean primarily in the form of garbage, industrial and construction wastes which are barged to sea or used as landfill in tidal areas. The dumping of dredge spoil and the disposal of munitions and other armed forces hardware also affect water quality or uses of ocean waters.

The San Diego and San Francisco Bay Regional Boards have adopted specific prohibitions on the disposal of solid wastes in certain areas and, as a general policy, each of the regional boards along the coast now prohibits the dumping of wastes from barges and vessels which may affect the quality of ocean waters within the territorial limits of California.

The State Board is also developing regulations for the disposal of liquid and solid wastes to land which may adversely affect ground or surface water quality. The proposed regulations

will classify land disposal sites and waste materials and regulate certain methods of operation of the sites.

D. OIL SPILL CONTROL AND CLEANUP

The State and Regional Boards have specific authority to control oil spills and cleanup operations and to license the materials used in cleanup operations. The Department of Fish and Game is authorized to enforce the regulations adopted by the Board for these purposes.

E. GENERAL PRINCIPLES FOR PROTECTION OF WATER QUALITY IN THE COASTAL ZONE

The following general principles or policy statement have been excerpted or derived from the specific policies and regulations previously described to serve as a guide to those planning developments on the coastal zone.

1. Activities and factors which may affect the quality of the waters shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible.
2. Wastewater management systems with discharge to the marine environment must assure protection of indigenous marine life and its diversity.
3. Special protection of water quality will be provided in the nearshore waters and in bays and estuaries since these are areas of high value for human use and they are indispensible for various forms of marine life.

The Board will designate areas of special biological significance after public hearing and consideration of all present and potential uses. The disposal of wastes will be limited to permit the maintenance of natural water quality conditions in such areas.

4. Municipal, agricultural and industrial wastewaters are an integral part of the total available fresh water resources. Disposal practices which preclude further use of either wastewater or receiving water after economically feasible methods of treatment shall be discouraged.
5. Wastewater reclamation and reuse systems which assure maximum benefit from available fresh water resources shall be encouraged. Reclamation systems must be an appropriate integral part of the long-range solution to the water resources needs of an area and incorporate provisions for salinity control and disposal of non-reclaimable residues.
6. Efficient wastewater management is dependent upon a balanced program of control of environmentally hazardous substances at their source, treatment of wastewaters, reuse of reclaimed water and proper disposal of effluents and residuals.
7. Wastewater discharged to the marine environment must not contain (a) material which is floatable or may become floatable upon discharge to the marine environment, (b) settleable material or substances which may form

sediments which may adversely affect benthic communities or other aquatic life, (c) substances in concentrations which may be toxic to marine organisms due to increases in concentrations in marine waters or sediments, (d) substances in concentrations which may decrease the penetration of natural light through the water column, or (e) materials which may result in esthetically undesirable discoloration of the ocean surface.

8. Waste discharges must be located in the area that will assure maximum environmental protection after a detailed assessment of the physical oceanographic characteristics and current patterns to assure that (a) pathogenic organisms and viruses will not be present in areas where shellfish may be harvested for human consumption, or in areas which may be used for swimming or other body contact sports, and (b) natural water quality conditions will be maintained in areas which have been designated as being of special biological significance.

9. Waste discharges at a temperature higher than that of the receiving water will be regulated to prevent adverse effects to marine life and to the beneficial use of waters in the coastal zone. Heated waste discharges will be prohibited in cold fresh water streams. In addition, all new discharges to bays and estuaries at a temperature higher than 4^{o} F. above the natural water temperature will be prohibited.

10. Disposal of either solid or liquid wastes at disposal sites on land will be regulated to provide full protection for usable ground and surface waters. The use of disposal wells and the sealing or closure after use shall be regulated to protect usable groundwater and groundwater aquifers.

11. The disposal of solid wastes to tidal lands shall be regulated to protect water quality from the direct effects of solid wastes and their leachates.

12. Landfill proposals on tidal lands will be reviewed to determine their effect on water quality and those which would degrade water quality as a result of changes in the physical characteristics of shorelines, estuaries, bays and harbors will be discouraged at every opportunity.

13. The dumping of solid wastes at sea which may affect the quality of waters within the territorial limits of California will be prohibited. The disposal of inert and nontoxic dredge spoils will be permitted

14. The quality of water in the tributaries to coastal waters will be maintained to provide protection for those beneficial uses which are particularly dependent on the estuarine and coastal areas.
in appropriate areas under strict regulations to protect marine life and other beneficial uses of coastal waters.

PART 3

HUMAN ECOLOGY IN THE COASTAL ZONE

The "intangible" environmental resources of the California coastal area may have an importance to health and well-being far beyond that of the material resources. Put in other words, the products of the coastal zone may be exceeded in value by the mere presence of the coast.

The coast has always been a popular vacation area for a change of scenery and a change of pace in living. The importance of the area has subtly shifted through the years with the increased pressures of daily life — the crowding, noise, odors and irritations of community living. A "change of scenery" has shifted to a "retreat" or "haven", a place where the sights, sounds, smells and feelings are different and pleasant and in some ways therapeutic.

Some have likened the bloodstream of animals to a "portable ocean" which had to be developed as a replacement for the nutritive waters which had washed around the organisms before they left the ocean environment for life on land. Certainly it is of deep evolutionary significance that the chemical composition of man's blood is similar to that of sea water. Perhaps there is some vestigal memory of the seaside shallows as the original home which makes the coast a soothing and refreshing environment. Whatever the reasons, the coast is assuming the role of a needed part of the "good life"; it is a part of the concept of "living long and dying young".

The significance of public health with relation to the coastal area has been expanding as the terms above would suggest from a disease prevention and control activity to a positive concept of providing a high quality of life. The goals have been raised from the necessities to the amenities.

In this chapter, the concept of health as it relates to the environment, including the coastal environment, is first discussed. The basic health problems and the activities for health protection associated with the ocean products and the uses of the area are then presented — this is the disease prevention-health protection concept of environmental health which is most important and cannot be taken for granted. Beyond that are discussed the less material resources of the coastal environmental media and the present activity (or lack thereof) for their protection. This indicates areas of need which are of positive health significance and which should be considered in an ocean area plan.

HEALTH AND HUMAN ECOLOGY

Changing Concepts

Human ecology involves a multidisciplinary approach to human problems which defies precise definition. A fluid definition which may be appropriate for the purposes of this report is: Human ecology is the study of man's survival and well-being in a changing environment. It involves both pathological and formative effects of total environment, and includes the indirect and delayed effects of environmental forces, even when these do not appear to cause significant damage at the time of exposure. It includes the positive influences of the environment on life as well as the negative factors.

Sound ecological concepts — pure air, pure food, pure water — have long been practiced by environmental health workers. These were supplemented by a shrewd understanding of man's emotional needs in urban areas, such as the advocation of trees, parks and beaches, or access to country roads. Thanks to their efforts, many infectious and nutritional diseases

have been practically eradicated. Unfortunately, the current revolution in the ways of life and the environment that is being created by a technological society is bringing about profound changes in disease patterns, causing alarming increases in various types of chronic and degenerative diseases. These so-called diseases of civilization are the result of man's failure to respond rapidly and successfully to the stresses of modern industrial environment. Very little is known about the etiology of these diseases, or of the methods for their treatment.

Although many of the infectious diseases appear to have been conquered or at least are under reasonable control, others are still with us. Many diseases which do not kill, but often ruin life, are caused by microbes, including various viruses, that are constantly present in the environment but become active only when the general resistance of the body is lowered. Control of infectious disease follows the time-honored practice of good sanitation, pure food, pure drinking water and safe bathing beaches, and there is every need for this to be continued in the future. It is necessary, however, to look further into measures which lift health efforts beyond the obvious direct disease controls.

The patterns of nutritional diseases facing us are changing. Malnutrition, which in the past was attributed to a plain shortage of food, is now caused mainly by deficient intake of proteins and certain vitamins. The importance of the ocean as a nutritional food source will be described later. Overeating, together with the lack of physical exercise and emotional tension, is now one of the chief causes of vascular disease. Certainly the enhancement and improved availability of recreational opportunities in the coastal zone could play an important role here.

In today's rapidly changing society, man finds himself under constant stress. Crowding, environmental pollution, emotional tensions, fear, insecurity, and even boredom are conditions which cause stress in modern, industrial society. These are largely the result of one's own making, and in this regard, it can be said that man makes himself. At this time at least a practical solution is seen as maintaining environmental conditions as they have been and the shoreline is one zone where this can be reasonably accomplished.

Environmental conditions change rapidly, partly because man manipulates them in an attempt to control the external world, but more because each technological and social innovation has unpredictable consequences. Stress was already known to Hippocrates, who observed that disease involves not only "pathos" (suffering) but also "phonos" (toil or struggle). He believed that illness was the struggle of the body to adapt to sudden changes in its environment. In early 20th century, stress was rediscovered by Hans Selye as "the syndrome of just being sick". Selye observed that patients with various kinds of infectious diseases initially had much the same symptoms: diffused aches and pains, coated tongue, intestinal upset and loss of appetite. These symptoms were, however, dismissed at that time as "nonspecific and of no use in diagnosis". Further studies lead Dr. Selye to develop his theory of a General Adaption Syndrome. This syndrome, provoked by stress, is susceptible of getting out of hand particularly in today's world, and sets the stage for disease, i.e. a body waiting for illness to happen. Hormones are the mediating substance, which by responding to the alarm of stress act to stabilize the body's system and preserve life. However, ringing the alarm too

often overstrains the system and leads to a breakdown. The result of breakdown are the "diseases of adaption", such as heart disease, ulcers, emphysema, erratic blood pressure, menstrual disorders or just "feeling sick".

Traditionally, the absence of illness or the curing of disease have been the aims of those concerned with health. In recent years, a broader understanding of the underlying mechanism of illness has led to a revision of traditional views. Modern public health practice is concerned with the whole man, including both the psychological and physical factors of disease. Health is now seen to depend upon the development of a satisfactory adjustment between an individual and his environment. A healthy human being is necessary for a healthy society, and conversely, a healthy society is necessary to a healthy human being. In recognition of this, the World Health Organization has redefined health as "the state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". Although such an ideal state might be impossible to achieve, it is a logical and desirable goal of health.

Positive Meaning of Health — Goals

In recent times the public also has become aware of the conflicts among exploitation, convenience and a deteriorating environment. Citizens are seeking better environments, not only to escape pollution but to achieve a better quality of life. Quiet, esthetically pleasing surroundings which provide relaxation and stimulate the intellect are in increasing demand. The need to live close to nature is reemphasized as being instrumental to the survival of civilization. On the other hand, the urban sprawl is continuing in California which may result in obliteration of natural areas. These concerns are reflected in recent governmental

action. In 1967, the Task Force on Environmental Health and Related Problems of the Department of Health, Education and Welfare concluded that environmental health practice must be concerned with the whole question of "livable environment" — not only the traditional air pollution, water pollution and solid waste, but also noise, crowding, radiation, traffic safety and ailments which can be related to these factors. These concepts were considered by a California legislative committee in the preparation of a proposed Environmental Bill of Rights which reads as follows:

> "It is hereby declared to be the policy of the State of California and a matter of statewide concern to develop and maintain a high quality environment in order to assure for the people of the state, now and in the future, clean air, pure water, freedom from excessive noise, and enjoyment of scenic, historic, natural and aesthetic values".

The continuing mission of the California Department of Public Health is to promote the highest level of health attainable for all Californians in an environment which contributes positively to healthful individual and family living. This necessitates attention to all the complex factors that influence health and that cause disease, disability, and death. It also demands the technical competence and resources to forestall potential threats to health as well as to ameliorate adversity.

Within this mission, departmental responsibility includes identifying those biological, physical, and social conditions in working, living, and recreational environments that are detrimental to healthful living;

planning and coordinating the provision of high quality comprehensive health services and facilities to all segments of the population for the prevention and control of disease and disability; and encouraging the full participation of the people in recognizing their health concerns and interests and taking appropriate action in relation to these.

Thus, both popular demand and public health practice today are concerned not only with the prevention of disease but also with the positive values of providing an enjoyable and meaningful life for the individual. The preservation of coastal and ocean resources is, without doubt, vital to these aims.

The following list may serve as the health associated goals and objectives:

1. Preservation of the natural resources of coastal zone for the benefit of man. In an increasingly crowded urban society these resources are necessary for the health and survival of human species by providing;
   a) relief from urban stress,
   b) relief from noise and air pollution,
   c) aesthetic enjoyment of nature and life,
   d) stimulation of the intellect, and
   e) unprecedented recreational opportunity.
2. Preservation of safe waters for the culture and processing of fish, shellfish and other ocean products.
3. Preservation of public beaches and of water safe for swimming and other water-contact sports.
4. Provision of safety for non-body contact recreation, such as pleasure boating and fishing.
5. Freedom from air pollution, noise pollution, urban congestion or other environmental hazards.

6. Provision in coastal zone of a) safe drinking water; b) adequate waste disposal, including sewage, industrial waste, radioactive waste and solid waste; and c) good environmental sanitation practices.
7. Provisions for adequate public beaches and other coastal recreational areas within commuting distance from urban centers.
8. Aggressive and enlightened development of positive health resources.

Therapeutic Aspects of Coastal Zone

The coastal zone, more so than any other natural area, may have great therapeutic value against some of the "diseases of civilization" discussed in the preceding sections. The therapeutic values lie primarily in relief from stress and the general uplifting of human spirits caused by outdoor recreation, change in environment or aesthetic enjoyment of nature.

The physicians of ancient Greece appreciated the curative effects of nature, and practiced their healing arts in sanctuaries built in beautiful surroundings. Nature cures also exist today in the form of spas and health resorts located near mineral springs. A long ocean voyage has been a popular cure for some chronic or emotional ailments. Even public parks were initially intended to "restore the health and improve the character". Aside from their magical connotations, these "cures" were achieved through recreation and relief from stress.

The coastal zone offers a wide and diversified variety of recreational opportunities, including swimming, surfing, skin diving, boating, fishing, clamming, hiking, sunbathing, nature exploration and sightseeing. Recreation not only fulfills a basic emotional need, but also

provides an important filler for leisure time and provides relief from stress. The therapeutic value of recreation as an aid in the treatment of disease is well known in the medical field, and its potentials are fully utilized in the hospitals. Isolation research points to the need for sensory input as necessary for proper function of the central nervous system. This input can be obtained from either work or play; however, that derived from recreation always has an egosyntonic or elevating effect on the individual.

Recreative play is an essential aspect of healthy life and provides the natural alternative to work. In the hospital it affords the patient a physiological escape from somatic pain and disruptive emotional experience, and supports the nonpathological elements of his personality. Recreation creates the milieu for successful treatment by taking the patient out of himself or diverting his attention away from pain and toward agreeable things. It reawakens the patient's interest in things that are fun to do and thus increases his determination to get well.

Similar therapeutic effects may also be found through outdoor recreation in the coastal zone. The relaxing effects of a day on the beach, an ocean fishing trip or an evening stroll on the waterfront are well known. These activities provide both relief from the strain of a hard day in the office, and fulfill the emotional needs for recreation.

HEALTH PROTECTION - OCEAN PRODUCTS AND USES

There are well-developed continuing programs which are carried out to assure the purity of products taken from the ocean and the sanitary quality of waters for recreation. These programs may be considered as

the basic line of defense for environmental health protection and they generally have little to do with environmental enhancement in their present form. The immediate control in the programs is generally directed against the ocean product or water use. For example, if waste discharges render water quality in an area unsuitable for commercial shellfish cultivation, the immediate program action is to prevent harvest or sale of the shellfish. While control at this point rather than at the source may appear unjust in some circumstances, it is the point where immediate control can be exercised best and then more deliberate action can proceed to correct the source of the problem.

Sanitation of Beaches and Recreational Areas

The beaches and waters along California's 1200 miles of shoreline provide an unbeatable recreational opportunity for Californians. Located on the shoreline are 63 State Beaches and Parks, the Point Reyes National Seashore, various county and municipal beaches, and numerous public and private marinas. Nearly three-fourths of the State's population lives within a one hour's drive from the coast, and a large portion of the population takes advantage of this proximity as is demonstrated by the crowded beaches on warm summer days. Problems experienced in such recreational areas include sewage contamination, oil spills and general lack of sanitation. As sometimes happens, the best and most frequently used recreational areas lie near sewage discharges. For example, at East Cliff the best surfing area is located directly above the sewage outfall. Contamination with sewage has, from time to time in the past, forced the closing of major public beaches. In the summer of 1970 the

following places were closed for water-contact sports or clamming by the State or local health authorities:

Sorrento Lagoon at Torrey Pines State Park

Oceanside Harbor

Bolinas Lagoon and part of Bolinas Bay

Caswell State Park Beach and Corte Madera Slough

San Rafael Bay

Richardson Bay

Napa River

San Mateo Beaches in San Francisco Bay

Areas of Monterey Bay, Pismo Beach, Humboldt Bay and Aquatic Park were posted at the start of the season but were opened later on.

In each case contamination by sewage discharges was the reason for closure.

The damage done to the Santa Barbara beaches by the recent oil spill from an offshore drilling platform is well known. The raw oil not only killed hundreds of aquatic birds but, by coating the shores with tar, made the beaches unusable for recreation. A similar but less catastrophic situation is created by the natural offshore oil seepage which has a perennial effect on the beaches. It is doubtful that an effective method to prevent or control this natural phenomena can be developed.

General sanitation is another problem. The beaches are often scattered with litter and garbage which destroy their aesthetic value. Sanitation and safety of bathers is generally supervised by the local health departments using their own guidelines. At present there are no statewide standards for beach sanitation; however, the recently passed

AB 726 (Priolo Bill) requires the State Department of Public Health to establish standards for sanitation of public beaches, including, but not limited to, removing refuse.

Sections 24155-24159 of the Health and Safety Code authorizes the Department of Public Health to supervise sanitation, healthfulness and safety of public beaches and water-contact sports areas of the ocean waters and bays of the State. However, the authority to designate the areas where water-contact sports may be engaged in is delegated to the various Regional Water Quality Control Boards, and areas have not been so designated.

In addition to water quality monitoring conducted by waste dischargers along the coast and in the bays, water quality surveillance is also conducted by the various Regional Boards and the State and local health departments. The program of the health departments consists of periodic investigations of water quality at all public beaches. This is done to determine compliance with physical and bacteriological requirements of "Ocean Water-Contact Sports Areas" Title 17, Sections 7950-7961, California Administrative Code. These statewide standards essentially require that there be no physical evidence of a sewage discharge visible at any time on any public beach or water-contact sports area and that the water quality meet certain bacterial limits. Coliform bacteria which are found in immense numbers in the wastes of warm blooded animals are used to indicate the possible presence of sewage in water. In fresh waters these organisms can exist for long periods and may also originate from soils; however, the ocean environment is an extremely hostile one for

both these indicator organisms and the waterborne pathogenic organisms which they trace. Consequently, the presence of large numbers of coliform bacteria in ocean water is considered fair evidence of pollution by sewage or other fecal matter.

Pathogenic organisms present in sewage which may cause enteric disease in bathers include typhoid and paratyphoid bacteria, various protozoa, the viruses of the enterovirus group — polio, coxsackie and echo viruses, and infectious hepatitis virus. In addition, sewage contains various cocci and viruses of the adenovirus group which are associated with upper respiratory illnesses.

Numerous outbreaks of typhoid fever attributed to swimming in polluted river water have been reported in Germany and the United States. A summary of typhoid epidemics in the United States and Canada from 1920 to 1936 identify four outbreaks and 35 cases attributed to swimming in polluted inland waters. An outbreak of 114 cases of dysentery has been attributed to bathing in Winona Lake, Indiana. Studies done by the Public Health Service at two Chicago beaches and in the Ohio River indicated that when the coliform bacteria MPN's were in the range of 2400/100 ml, there was a detectable increase in incidence of illness in bathers, especially gastrointestinal disorders, but possibly also upper respiratory.

There is also evidence of disease associated with bathing in sea water. Reports have been published of typhoid fever outbreaks associated with bathing in polluted coastal waters in England, Poland, New York, New Haven and Australia; however, these reports have been critized as having an inadequate epidemiological basis. The most recent typhoid outbreak, and the one with the most convincing evidence, was reported in 1961 in Perth, Australia. It involved ten cases where the source was attributed to bathing in polluted sea water.

The scarcity of epidemiological evidence has led many authorities to believe that bathing in polluted sea water carries only a negligible risk to health unless the water is so fouled as to be aesthetically revolting. This view is not justified, for it ignores the fact that no comprehensive and epidemiologically sound study has ever been done. Moreover, many illnesses are not reported, and in our mobile society it is extremely difficult to trace the source of illness even when it is reported. The possibility of infection is always there when sewage is present in bathing water, and the bacteriological standards provide a safety factor against disease transmission.

In 1942 the Department of Public Health conducted a comprehensive study of Santa Monica beaches. In that study it soon became apparent that high coliform bacteria levels were generally associated with large amounts of sewage solids, including grease, on the beaches. Sewage solids were present on the beach whenever the coliform bacteria levels of the surf water reached 1000/100 ml. Paratyphoid organisms were isolated from the surf waters, sand, and sewage grease, clearly pointing to a health hazard. Although only one reported case of paratyphoid was attributed to this contamination, the actual number of persons who might have been infected is not known, for the inapparent or light infections are usually not reported or diagnosed as such.

Recent studies show that both enteric viruses and Salmonella organisms are present in polluted sea water. Researchers studied the effect of sewage treatment and disinfection on the pathogen levels in a New Hampshire estuary. Prior to the installation of a new wastewater treatment plant, Salmonella organisms and enteric viruses were isolated

at high frequencies from both the sea water and oysters grown in that water. The pathogen isolations were dramatically reduced after the new treatment plant was put in service. In another study in Raritan Bay, the percent of samples positive for Salmonella organisms increased in direct relation with coliform and fecal coliform bacteria. However, a few samples contained Salmonella even at low coliform concentrations.

A quarantine of Bolinas Lagoon and the immediate ocean waters was imposed in June 1970 because of the discharge of untreated sewage to the waters at the mouth of the Lagoon. Shortly thereafter, there were 12 cases of infectious hepatitis in the small community of Bolinas which may have been related in part to the polluted waters.

It may be concluded that there is definitely a health hazard associated with bathing in polluted sea water, and that the bacteriological standards based on an indicator organism greatly reduce that hazard but do not eliminate it.

Shellfish

The commercial shellfish industry in California consists almost exclusively of the cultivation of oysters. The only species that can be grown productively in California waters is the Pacific or Japanese Oyster. The California growers import most of their oyster seed or spat from Japan and place it in waters which have been approved by the State Department of Public Health. There are five commercial growing areas in California: Humboldt Bay, Drakes Estero, Tomales Bay, Morro Bay, and Encina Lagoon. Almost 90 percent of the commercial oysters are grown at Humboldt Bay.

There are a few commercial clamming operations throughout the State. In order to commercially harvest clams the operator must obtain a commercial fishing license from the State Department of Fish and Game. The licensed commercial clammers harvest no more than a few hundred pounds of clams each year.

The gathering of clams and mussels by the general public for their own use is popular at many locations along the California coast and in the bays. There is a coordinated program among several agencies to see that areas where sport shellfishing is popular do not become contaminated or conversely that clamming is not allowed in unsuitable waters. The local health departments usually carry out the program of posting unsafe clamming areas and providing information to the public.

Authority for control over the use of State waters for shellfish cultivation is granted to the Department of Public Health by Sections 5670-5674 of the Fish and Game Code. The Department is also authorized to establish quarantines for the protection of the public health against shellfish toxin or sewage contamination by Section 3051 of the Health and Safety Code. Quarterly inspections and annual certification of 21 operations including growing areas, packing, repacking and reshipping plants is conducted by the Department.

A firm must be placed on the Interstate Shellfish Shippers List to sell products outside California. The Interstate Program is administered under the Federal Food and Drug Administration (FDA) which requires the shellfish processors to meet certain uniform standards of sanitation and product quality. The individual states participating in the Federal program are responsible for conducting inspections and surveillance which will assure compliance.

Oysters, clams, and mussels have an unusual potential for the transmission of disease to man. This potential may be attributed to three factors:

1. The environmental growth tolerances of shellfish are such that they ordinarily grow only in estuaries in which there is an admixture of fresh and saline water. These are also the areas subject to both industrial and municipal waste pollution.
2. Shellfish are filter feeders. In the process of feeding they pump large quantities of water across their gill systems. Particulate matter and dissolved substances are removed and concentrated to levels greater than that of the overlying waters. Bacteria have been shown to be concentrated by quahogs to a level of 2.5 to 6.0 times that of the water while the concentration factor for metals, industrial waste components or pesticides may be much greater. For example, one investigator observed that some oysters have a zinc concentration-retention factor of 175,000 to one.
3. Shellfish are often eaten raw or with little cooking and the entire flesh of the animal is consumed.

Historically, typhoid fever has been linked with shellfish polluted with human sewage. In recent years, however, the prime offender has been infectious hepatitis — at least in other parts of the country. Outbreaks have been related to shellfish taken from the Gulf and East Coast areas. A potential effect of industrial waste on health through shellfish is indicated by experience in Japan where 83 cases of severe mercury poisoning were attributed to waste discharge from a plastics manufacturing plant.

Another threat to the public health through shellfish comes from land runoff in agricultural areas. Elkhorn Slough in Monterey County is an example of a growing area which was closed because of agricultural pollution. Three dairies along the slough contributed a flow of over 1.5 million gallons per day of barn and land drainage, with a coliform content up to 2 million coliform bacteria per 100 ml. As a result, the entire slough not only exceeded the shellfish growing water standard of 70 per 100 ml. but also exceeded the more liberal standards allowed for water contact sports. The last of the commercial shellfish beds was closed down in 1967 because of the bacterial contamination. This area is also one of eleven sites sampled by the Department of Fish and Game for pesticide residues in shellfish. Pesticide residuals found in Elkhorn Slough shellfish have been consistently higher than those found at any other station in the State and may be a result of the drainage waters.

Each year a quarantine is imposed on mussels effective May 1 through October 31. The quarantine is imposed because mussels, along with clams and oysters, are plankton feeders and one plankton genus, Gonyaulax, contains an extremely poisonous neurotoxin. The poison produces symptoms in humans similar to those associated with strychnine poison. The quarantine may be extended on either end of the season depending on the results of the toxin surveillance program. Approximately 250 shellfish specimens are collected annually along the coastline for toxin analysis in order to determine the status of the problem at any time.

The annual quarantine dates were chosen because the high toxin values usually occur during the summer months as the quantities of the causative organism increases in the growing waters. At present there are no means to predict periods of high toxin.

Records show that from 1927 through 1969 there were 41 outbreaks of shellfish poisoning in California that resulted in 388 cases and 30 deaths. Twenty of the cases were due to clams which resulted in 5 deaths. The remaining 25 deaths were due to the ingestion of mussels. In 1962, the first and thus far the only incident of poisoning attributed to toxic oysters was reported.

The quarantine program has been effective. In the 14 years prior to it, there were 346 cases with 24 deaths. In the 28 years since, there were only 42 reported cases resulting in 6 deaths.

Fish Processing and Canning

Processed and canned fish are a major product of the California ocean waters. In FY 1968-69, over 11.2 million cases of high quality canned fish were produced in California at 15 canneries along the coast. A full-time mandatory inspection program is carried out at each facility. An inspector of the Department of Public Health is at the plant each day that it is in operation. He is responsible for overseeing the sanitation of the entire plant and warehouse, fishing boats, loading docks and surroundings. Fish are examined prior to unloading and as they are unloaded when gross spoilage can be detected. In the butchering or cutting room, the fish are inspected for general appearance and odor. In large fish such as tuna, a second careful examination is made after the precook and cleaning for detection of honeycomb material. Small fish such as mackerel

are reexamined at the packing tables. The retorting and sealing equipment and operation is under close control on a batch basis and final checks of the product are conducted.

From this brief description, it is apparent that fish processing is one of the most closely controlled food operations in the State. While the potential exists for transmission of disease and poisoning of many types through the media of fish, the one organism which far outshadows all others in the purview of public health is Clostridium botulinum.

The strains of this organism have been divided into 5 types according to the specific different antitoxin that the toxin from a strain produces. Three of the five types, C. botulinum A, B and E, produce botulism in humans. In one form or another, the organisms causing botulism are distributed in small numbers all over the world. Calculations have shown that 15 or 20 grams of pure toxin is sufficient to kill all the people in the world today — it is the most poisonous substance known to exist in nature. Generally, it is Type E which concerns the fishing industry. This type is most abundant in the more northern waters of the hemisphere and in coastal soils. About 84 percent of mud samples of Copenhagen Harbor contained Type E spores and surveys have shown the organism in the intestinal contents of both freshwater and marine fish. Of the 48 recorded outbreaks caused by Type E (up to 1962), 47 were caused by the consumption of fish or other seafood.

The last occurrence relating to California commercial canning operations was botulinus contaminated tuna in 1963. Two deaths occurred and 181 truckloads of canned tuna were confiscated and destroyed. A suspected cause was poorly sealed cans and cooling water containing C. botulinum spores.

Smoked fish products, particularly ones vacuum packed in plastic, have been implicated in botulism cases elsewhere and the products must be carefully processed and refrigerated for assured safety. It has been noted in studies along the Washington-Oregon coast that high percentages of Dungenees crabs have contained C. botulinum.

Salt Production

Common salt, magnesium compounds, bromine and artificial gypsum valued at over $11 million were produced from 50,000 acres of solar evaporation ponds formed on tidelands fronting on the San Francisco Bay system in Alameda, Santa Clara, San Mateo and Napa Counties. Basically, seawater (3.5 percent salt) is allowed to enter a series of large ponds where sedimentation and evaporation occur. The salt is harvested for refining by kiln drying which renders the product safe but not clean of foreign matter. Some of the problems attributed to the kiln dried product are associated with the presence of metallic salts, vis., copper and iron may have deleterious effects such as mottling or discoloration when used in butter processing. On occasion, large volume users of brine such as olive processors have attempted to use kiln dried salt in place of a more refined product.

For food manufacturing operations, a higher grade of salt is required. Impurities left after kiln drying are removed through a succession of recrystalization processes whereby a product which meets Federal standards of purity is produced.

Inasmuch as the cost of the high grade product is only a few cents a ton higher than kiln dried salt, there is little incentive for attempting to use the inferior grade. No problems pertaining to the processed

product have been reported on a State level. The Federal Food and Drug Administration also reports that no health problems have arisen in the use of processed salt throughout the nation.

Kelp

In favorable years, kelp beds have extended over 100 square miles along the Southern California coast — the Point Loma beds alone have produced resources valued at $1 million per year. The Southern California beds are unique in that they are accessible year-round and are close to industrial centers. The harvesting is controlled by the California Fish and Game Commission. The harvesting process may have the added side benefit of lessening the litter which floats to adjacent beaches.

Kelp contains iodine, potassium, and other minerals and vitamins. Algin, a natural gum substance extracted from kelp, has gel-producing and colloidal properties which make it extremely valuable. The catagories of products in which algin is used include both food and dairy products. Specifically:

Bakery icings and meringues	Ice cream
Frozen foods	Chocolate milk
Salad dressing	Cheese
Fountain syrups	Sherbert
Candy	Sterilized cream
Puddings	

The algin is produced by a complex multi-stage chemical and physical process.

A more direct use of kelp from the Southern California coast is that of animal feed. The kelp is harvested, dried, ground, and packed for use as a supplemental feed for cattle, poultry, swine and other animals. The product is checked for purity and composition by the Department of Public Health.

There are no particular public health hazards which have been identified with the use of kelp products from the California coast.

Solid Waste Disposal

A common use of shoreline areas of bay systems, particularly the San Francisco Bay-Delta system, has been solid waste disposal. Inasmuch as a separate chapter of the report will be devoted to the subject of solid waste disposal in the coastal zone, the subject is only briefly mentioned here and in the context of how it applies to health.

Twelve units within the California State Government system have program activities that relate to solid waste disposal. These activities, for the most part, deal with limited studies and field investigations. There is no State planning or management program either overall or for any phase of the program. Activity, control and planning is at the local level.

Solid wastes pollute land, water and air and generally reduce the aesthetic character of the environment.

Principal effects related directly to health include:

Harborage and support of large populations of flies, rodents and other vectors of disease;

Safety hazards due to fires, explosions, toxic materials and exposure to unsafe materials;

Water pollution due to seepage or percolating waters;

Air pollution due to combustion, dust and odors.

The use of shoreline areas for dump sites removes these areas for indefinite periods from uses which might exert a positive health influence and dumps generally make their presence felt far beyond the actual physical boundaries.

Solid waste problems peculiar to the immediate coastline have been partially mentioned under the preceding "water" heading and include litter and debris, oily deposits and naturally occurring deposits of organic matter from the sea, including both plant and animal remains.

Recent authority given the State Department of Public Health to establish standards for the sanitation of public beaches including removal of refuse should provide improved control over the appearance of the coast.

A positive approach has been taken in the Mission Bay area where unsightly deposits of rotting kelp have detracted from the beach areas. The kelp is collected, mixed with treated sewage sludge, mulched and used to fertilize all San Diego parks.

Pesticides

Fish, being at the top of the aquatic food chain, eventually can be the recipients of a large part of the pesticides discharged into the aquatic environment because of the accumulating effect along the chain. The main concern is with the organochloride group, including DDT and allied compounds and the aldrin-dieldrin group. These chemicals are accumulated in blood and body fat of the fish and could reach concentrations toxic to man. In addition, long term consumption of low levels of pesticide may have carcinogenic, teratogenic or mutagenic effects on humans.

A number of separate pesticide programs or studies have been conducted in California. These have mainly been special studies carried out by State and Federal agencies and directed at certain types of aquatic life. In 1964, the U.S. Food and Drug Administration studied pesticide levels in shrimp and oysters. The California Department of Fish and Game since 1966 has conducted a program of monitoring pesticide levels in oysters, mussels and crabs in California bays and estuaries under contract to the U.S. Bureau of Commercial Fisheries. Pesticide levels in shellfish were found to be significantly higher in areas influenced by urban and agricultural areas, and the pesticide levels in Southern California shellfish were as much as three times higher than those from Northern and Central California.

In 1969 the Federal Water Quality Administration tested the livers of fish toxin from San Francisco Bay. The DDT and dieldrin levels were very high in the livers of distressed fish. In Monterey Bay, the Hopkins Marine Station of the Stanford University since 1969 has been measuring DDT residual in fish and shellfish, however, the levels found are low.

The U.S. Bureau of Sports Fisheries and Wildlife is presently conducting continuous monitoring of DDT in fish at two locations in Tiburon — Keil Cove and Paradise Beach, as part of the waste discharge monitoring program for their marine laboratory discharge.

The Department of Water Resources has a program of monitoring pesticide levels in surface waters and agricultural drainage in the Sacramento and San Joaquin rivers. This program also includes a few stations in San Francisco Bay, down to Treasure Island.

The Department of Public Health has done limited pesticide sampling in shellfish in a few sensitive areas, however, the levels have usually been low. A limited monitoring of pesticides in mackerel is conducted. These near-shore feeders would be expected to be sensitive to land based sources of pesticides.

A State-Federal cooperative study is underway in Southern California to determine the sources of high pesticide concentrations in waste discharges and their effect on marine biota. The study is coordinated by the Federal Water Quality Administration.

The lack of a total coordinated pesticide program is recognized, and the subject is under study by the State Water Resources Control Board. The study is intended to provide recommendations to the State Pesticide Advisory Committee on the establishment of such a program.

ENHANCEMENT OF POSITIVE HEALTH RESOURCES

The programs described above were principally developed and directed at environmental health protection through disease prevention, although there certainly is no clear dividing line where definite disease prevention stops and promotion of health through environmental protection and enhancement begins. There is a gradual shading from one to the other through the entire spectrum of activities which could be grouped under environmental health.

The programs which relate to environmental media — land, water, air — generally contain more in the way of positive health promotion through environmental enhancement than do those programs related to specific ocean products and uses. Environmental programs as they affect and control air and water quality are well established and they include,

to varying degrees, environmental protection considerations beyond those which provide merely adequate conditions for life. In the areas of noise and visual enhancement or preservation, program activities to date have been generally lacking. In all areas of environmental quality, to different degrees, the programs have been responsive rather than anticipatory. The tendency has been to act following an event and guard against reoccurrence. Protection of the intangible parameters associated with coastal development requires handling in such a way as to assure that the delicate balance between development and preservation of the environment is maintained. For such protection, a responsive program would be inadequate.

Eugene Odum, President of the Ecological Society of America, expressed the situation as follows:

> "Society needs, and must find as quickly as possible, a way to deal with the landscape as a whole, so that manipulative skills (that is technology) will not run too far ahead of our understanding of the impact of change."

The basic problem is to provide the needed and desirable development while preserving the positive, extant environmental features. It is well established that aesthetic considerations are an important beneficial aspect of any environmental area, and particularly of an area which is so closely related to the relief of normal stress. In order to obtain the benefits potentially afforded by the area and thereby enhance the environment as a whole and human ecology more specifically, the intangible aspects of the coastal environment must be fully recognized, preserved, and where necessary, salvaged.

Water

There are sixteen units of State government involved in different aspects of water programs in California. These programs, in general, have been more directed at fresh waters than at the brackish and saline waters of the coastal zone. Overall management resides in the State Water Resources Control Board.

A positive health resource of the coastal area is certainly a water which is aesthetically attractive and which encourages water-based recreation. This would require the absence of slicks, turbidity, sludges, water-based odors, color, foam, floating or submerged debris and many other appearances which are either outright objectionable or detract from the water use.

A common and persistent problem is the contribution of litter and debris which is deposited in the waters of bays and estuaries from vessels and shore facilities.

Oil slicks and sludges due to nature and man's activities have detracted from recreational water use along the Southern California coast. Spotting of beaches by black, viscous oily material is a chronic condition along the coastline with considerable variation from place to place. Tarry oil is a nuisance to beach users; it adheres to bodies and clothing. Incidents necessitating the closure and cleaning of many miles of beachline have occurred even prior to the Santa Barbara incident of 1969.

Turbidity detracts from the appearance of the water, reduces underwater visibility for skin divers and is a safety hazard to swimmers and boaters. The causes may be phytoplankton blooms, turbid runoff or a turbid discharge. The offshore turbidity may be completely due to wave-induce resuspension of sediment.

The water quality control policies for coastal waters established by the Regional Water Quality Control Boards generally specify that there be no material in coastal waters, other than of natural origin, in amounts which would create aesthetically objectionable conditions.

The present program activity is generally at the level of preventing actual pollution and contamination (where pollution is an alteration of water quality which unreasonably affects the waters for beneficial uses).

Even at the pollution control level there are startling unknowns and a positive program must reach down to this point. The impact of coastal waste disposal on marine life is uncertain. The changes in life patterns of herbivores, loss of kelp beds, recent sea lion deaths, mercury in seal livers and the changes in species diversity near outfalls are examples of possible consequences. The content and effects of storm water runoff described as "sweeping the grime of civilization to the sea" must be identified.

In order to enhance health potential of the coastal waters, the desirable and necessary water characteristics for various activities need to be identified and related to a coastal inventory which identifies areas having the desired characteristics. This would go beyond the quality requirements for beneficial uses which is used in setting waste discharge requirements. It would include the natural physical attributes of the coast. For example, surfing would require a strong, reliable wave action whereas this would be a negative factor in boating. One bottom condition might be essential for a use and preclude another.

This "best use" approach to water conditions could be carried further by considering the scarcity or plentitude of conditions for one use or another in planning water and land use. If only one coastal area of

the State had all the desirable attributes for a particular use, this use could be emphasized over another which had alternative locations available.

The health oriented aspects of this approach are more obvious and direct when considered in the context of recreation, but even optimization of industrial water use may have positive health implications. Full utilization of currents, natural water temperature gradients and dispersion characteristics could reduce the adverse effect of many an industrial operation on the environment.

While the concept expressed above is not new for selection of individual use sites, a comprehensive approach for an array of uses has not been employed and should be pursued.

Air

Air pollution is neither an emerging problem which has recently come under public scrutiny, nor is it an old and well understood problem which needs just a little more effort to reach a stable, controlled condition. Rather, air pollution is a present, serious, enlarging problem, which is intimately tied to our soaring and apparently irreversible energy needs (including those for transportation) and the unchangeable physical and climatological features of the State.

There are over a dozen units of State government involved in different aspects of air quality activities where air quality interfaces with their overall missions, but the principal authority is vested in the Air Resources Board which coordinates control activity, performs monitoring, establishes standards, and adopts vehicle emission standards and test procedures.

Air pollution ranges across a wide spectrum of health and economics — endangering human life, causing nuisances, damaging vegetation and impairing property. Severe effects including death has occurred on several occasions (Meuse Valley 1930, Donora 1948, Posa Rica 1950, London 1962). Chronic pulmonary disease, aggravation of heart diseases, and transitory irritation of eyes, nose and throat is related to air pollutants. There must certainly be a depressing effect associated with a discolored sky and soiled surroundings and with the darkening house paint, corroding metals, cracking rubber and smudged clothing which come with various forms of airborne pollutants. From a purely economic standpoint, the annual cost has been estimated to be $65 to each person in the United States.

Ambient air quality standards have been established to provide a basis for preventing or abating the effects of air pollution, including the effects on health aesthetics and economy. Ordinarily, pollution levels falling within the standards should not produce adverse effects. The goal of air pollution control in the United States has been to "maintain a reasonable degree of purity of our air resources..." Both the goal and the standards indicate that the control program has not reached the point where a positive approach to the air resource is being implemented.

In several ways, the coastal zone has attracted and experienced air pollution sources and problems which are peculiar to it. Oil refinery development has occurred principally along the coast because the oil and the facilities to move it are there. Power plants are frequently sited at or near coastal location; high volume needs for cooling water necessitate the location and indications are that pressures of water pollution

control may further restrict inland sites. Pulp and paper mills and other heavy industries which may be air pollution sources have been attracted to the coastal zone for the water as a coolant and transport media.

Several natural phenomena peculiar only to coastal areas also present air carried nuisances. These include the mud flat and lagoon areas and the kelp and other natural organic deposits on beaches and intertidal zones which create odors in addition to vector breeding.

The physical barrier of the coastal mountain range prevents a flow of air contaminants away from coastal sources. The problem is increased by the seasonal formation of long lasting temperature inversions which put a natural lid of warmer air atop the cooler air within the coastal air basin.

In spite of the direction of present air pollution control activities to regain a safe quality air and the special problems of the coast, there appears to be an opportunity for a supportive positive program toward air resources which could enhance the health aspects of the area. Climatological conditions in the various coastal airsheds should be surveyed with a view to determine specific areas which most often meet use needs. An out-of-state example is that of the area near Sequim, Washington. Although it is only a short drive from the heaviest rainfall area of the United States, it is in the shadow of the Olympic Peninsula Mountains and receives very little rain. It can, therefore, serve as a comfortable base camp for excursions into the nearby rain forests. Similarly, there may be coastal spots of California which have less fog,

lighter winds or which sustain cleaner and more comfortable air characteristics. There may be natural protective features which would be more beneficial for one use of the area than another. Perhaps there are areas where natural air flushing action would allow more intense industry. The "atmospheric needs" of different coastal uses should be identified and related to atmospheric characteristics which are naturally available.

The perpetual movement of air is from west to east, assuring thousands of miles of natural purification for air flowing into the coastal area and providing the clean basic ingredient with which to plan. The positive health aspects of the coastal air environment do exist and should be pursued in a coastal area plan.

Land

Proper planning for the use of coastal zone land is the keystone of an ocean area plan. All of the other environmental elements of the coastal zone depend in varying degrees on enlightened land use policies to achieve their potential as positive health factors. Land use planning is essential, but it also contains complex political, economic and social issues and conflicts.

While there are a number of State agencies involved in land management, most of their activities are confined to specific public lands. The responsibility for land use in California has been vested in local government; consequently, the planning and control have been fragmented and have taken different directions. (An exception is provided by the Bay Conservation and Development Commission which provides some regional control to land development along the immediate San Francisco Bay shore.)

Competition and conflict are the principal problems of coastal land use. From the major incompatibilities obvious between an industrial versus a wildlife use of a coastal marsh to the minor conflicts such as surfing and security at the Western White House, any number of examples can be identified. The matrices of coastline uses and effects prepared for Comprehensive Ocean Area Plan do this well.

The problem has been described accurately in the report "Environmental Quality".

> "Competition for the use of the limited coastal zone is intense. Shipping activities are increasing, with larger vessels needing deeper channels. Mining and oil drilling in coastal waters grow daily. Urban areas expanding throughout the coastal zone continue to enlarge their influence over these waters. Industrial and residential developments compete to fill wetlands for building sites. Airport and highway construction follows and further directs growth patterns in the coastal zone. Recreation — from enjoyment of the surf and beaches to fishing, hunting, and pleasure boating — becomes more congested as available areas diminish. Since over 90 percent of U.S. fishery yields come from coastal waters, the dependence of the commercial fisheries industry on a stable estuarine system is obvious.
>
> "Although some uses of coastal areas are undoubtedly necessary, many are not. Much industry, housing, and transportation could be sited elsewhere."

There are many examples of coastal area enhancement through imaginative land use. One is the transformation of Monterey's Cannery Row from a blighted and outmoded industrial area to a financially successful tourist attraction. The reclamation and development of Mission Bay is another example of enhancement of an area. Certainly the entire coastline need not be beautified and industry prohibited, but a Ghirardelli Square in an otherwise drab coastal community could have a definite spirit lifting effect.

It would be presumptuous and patently impossible to attempt an evaluation of land use issues here, however, it is appropriate to indicate some of the considerations of land use which generally tend to enhance the environmental health. The ocean area plan should consider the following:

1. Provision for weighting positive health features in determining land use;
2. Preservation or enhancement of aesthetic quality in land uses;
3. Unique or historical features should be preserved for public enjoyment;
4. Uniformity of man-made structures which compound the drabness of an area should be avoided;
5. Provisions for access to the water or scenic areas should be provided;
6. Every opportunity should be pursued which brings the people and their structures in closer harmony to the natural coastal environment.

Sound

Noise pollution is an emerging field of environmental concern and, as a consequence of being a newly recognized issue, most of the present activity is directed at defining the problems and their effects. There have been only minor moves to control certain sources of noise — vehicular and industrial — and a comprehensive program is lacking and needed.

The limited controls over the unwanted side of sound, i.e. noise, are established at the "tolerable" level which implies the allowance of a certain degree of unpleasantness. Former President Johnson has forecasted the importance of the problem:

> "(noise) is more than an irritating nuisance. It intrudes on privacy, shatters serenity, and can inflict pain. We dare not be complacent about this ever mounting volume of noise. In the years ahead, it can bring even more discomfort — and worse — to the lives of people."

Similarly, Dr. Roger Egeberg, Assistant Secretary of the Department of Health, Education and Welfare, sees noise as the number one health problem at the turn of the century.

General community noise has been reportedly increasing at the rate of a decibel a year for the past 30 years and is approaching the general irritation level. The effects, both psychological and physiological, include:

Hearing loss	Fear
Pain	Interference with an activity
Irritation	Alarm
Fatigue and stress	Annoyance

The threshold of human stress response to noise has been estimated to be about 65 decibels. At this point, stress reactions may result from a widespread activation of the autonomic nervous system. Far below this stress level a significant fraction of the population suffer from sleep disturbance (45 decibels) and interference with normal conversation, office work and classroom learning.

There are certain noises which are often associated with, or are unique to, the coastal zone. Major airports are generally located along the coast or bay shores. The location is favored due to easier acquisition of large land parcels, expansion possibilities, sites relatively close in to the cities and naturally clear flight approaches. Airplane associated noise is one of the most objectionable. It is intermittent, high intensity, frequent and unanticipated. Its impact follows along flight corridors far beyond the airport focal point.

The natural site for highway and heavily used local roads connecting the coastal communities is along the coast. Beyond the adverse effects of this physical barrier along the coastline, the vehicle noise can be a significant negative factor to enjoyment of the area.

Water traffic noises, foghorns and the like, are probably as much enjoyed by some as a flavor of the area as they are repellent to others for whom the sounds are too loud and frequent.

The foghorn example serves to introduce a unique positive resource of the coast with regard to sound. If the goal of environmental noise control is its absence, it might be projected that silence is the ultimate. But the complete lack of expected background sound is unsettling, whether it is the lack of audience laughter in a TV comedy show or the

quiet of a deserted street in the early morning hours. The coast has a built-in, comforting sound of surf, wind and gulls, wood creaks and water movements and other sounds of natural actions. These are an extremely valuable asset and a positive health resource which should be fully recognized and exploited in a coastal plan. Certainly this would include (1) the suppression or dampening of objectionable or interfering noise, (2) identification of activities which could most benefit from the presence of these natural sounds and ways the maximum benefits could be achieved, (3) new concepts in design and construction to lessen distance and sound muffling factors, (4) identification and full utilization of sound-rich areas, (5) basic changes in planning and development to recognize and utilize the natural sound resource.

Food

Between now (1970) and the end of the century, barring some type of catastrophe, the population of the world will more than double. The mushrooming population is often and accurately accused of being the basic cause of many environmental problems at the State, National and World levels. The usual consequences ascribed to more people are congestion, urban sprawl, water and air pollution, energy needs, and depletion of natural resources. The very direct connections of food supply to the environment as well as health are considered somehow different and separate from other environmental issues. The recent comprehensive report of the Council on Environmental Quality, for example, contains only brief mention of food supply and needs and the report "The World Food Problem" by the President's Science Advisory Committee does not thoroughly explain the interfaces of the food problem with other environmental matters. The

prospects regarding food supply are sufficiently harsh to warrant consideration of food production in every possible context which could improve the outlook. The coastal environment is one which has great potential in this regard.

Inadequate food supply has been an old and constant spectre in many parts of the world. The problem is particularly acute in developing countries which have the highest population growth rates, but where the existing methods of agriculture are inadequate in coping with the increased demands. The more prevalent deficiencies include diets which have too low a caloric intake (undernourishment) and diets which are inadequate in nutritional quality, often a protein deficiency. Malnutrition encourages infectious diseases, causes retardation of physical growth and may impair mental development. Pregnant women, nursing mothers and preschool children are particularly affected. Vitamin and mineral deficiencies may lead to many specific ills — anemias, endemic goiter (iodine deficiency), xerophthalmia (vitamin A deficiency) beriberi (thiamine deficiency) and numerous others.

The need for protein relates to a requirement for certain essential amino acids. Although plant proteins can also supply amino acids, the protein from animal sources more often contain a full complement in near-optimum proportions.

Counter to the food problems in other parts of the world, excessive caloric intake or dietary imbalance by choice are significant forms of health problems in many portions of the United States. One adverse effect of a "rich" diet which has received prominent attention is related to consumption of saturated fats present in animal meats and products.

Cholesterol plays an uncertain role in a relation between the form and content of fat in the diet and the development of heart and blood vessel disease.

Food from the sea has the potential for satisfying a significant portion of the world's nutritional needs. The value of the sea as a food supply was recognized by the late President John F. Kennedy:

> "The sea offers a wealth of nutritional resources. They already are a principal source of protein. They can provide many times the current food supply if we learn how to garner and husband this self renewing larder. To meet the vast needs of an expanding population, the bounty of the sea must be made more available. Within two decades, our own nation will require over a million more tons of seafood than we now have".

According to the President's Science Advisory Committee, the ocean is ultimately capable of producing 2,000 million tons of harvestable fish annually, which is enough to support the minimum protein requirements of 33 billion people. This, of course, presupposes new technology and full utilization of all resources. The food supply can be further expanded by the utilization of the vast supply of plankton and kelp in addition to fish. The importance of the coastal waters to fish production becomes clear when the productivities of the various ocean zones are compared. Nearly 60 percent of the total fish production occurs in the relative narrow coastal zones; most of the remainder occurs in the upwelling zones, and only a small fraction in vast areas of deep ocean.

Seafood is an excellent natural source of essential trace minerals, including iodine, copper, manganese, selenium and molybdenum as well as many macrominerals needed in the diet. Simple goiter, related to a deficiency of iodine may be prevented by the inclusion of seafoods as a regular part of the diet.

Seafoods also provide a rich source of many needed vitamins. Vitamins B_{12}, D and A have been harvested commercially from certain types of fish.

Fish and food of vegetable origin are low in cholesterol and are recommended by the American Heart Association as a means of lessening the likelihood of heart disease.

The effort thus far has been to prevent detrimental effects to aquatic life rather than actively pursue methods to optimize the food supply aspect of the resource. This has been a significant effort when the problems of preservation are identified. The coastal waters are directly affected by pollutants, including pesticides, radioactive wastes and heavy metals which are absorbed by the sea's plants and animals. These substances may not only make the fish and other seafood unsafe or unpalatable for human consumption, but in some cases by being toxic to fish themselves, they may destroy the resource. Waste discharges may play a role in disturbing the food chain and upsetting the natural balance of the underwater environment.

In confined waters, the combined toxic properties of the discharge may limit aquatic life as may the sediments, oxygen depleting substances and other pollutants. Physical alternatives of the coastal zone may

destroy the food base of many life forms which themselves serve as food and eliminate the environmental incubators of many species. Dams, diversions and releases can confuse and block migratory life and flood or flush spawning areas.

Much more information is needed regarding the effects of man's activities and wastes for assured preservation of aquatic life, however, this does not negate the possibility of pursuing a more positive approach enhancing this essential food resource.

A positive plan of action would include (1) greater environmental recognition of the food potential of the ocean resource, (2) an evaluation of the optimum environmental needs of the aquatic community, (3) an inventory of the coastal resource to determine the most productive areas and those which should be reserved for food production, (4) development and implementation of complete ocean food management system rather than the present, single-phase harvesting operation, and (5) more active contribution to the research and development of such programs as that involving fish protein concentrate (FPC).

These and other positive plans should be included to enhance this positive health resource of the ocean.